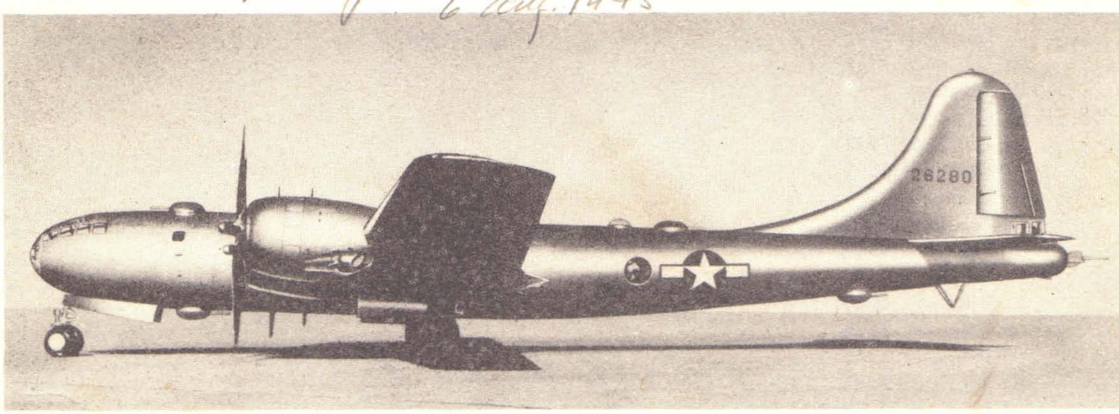
PILOT'S FLIGHT OPERATING INSTRUCTIONS

FOR

ARMY MODELS

B-29 and B-29A AIRPLANES

Dutch Van Kirk
Navigator - Enola Gay
6 Aug. 1945



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LIST OF REVISED PAGES ISSUED

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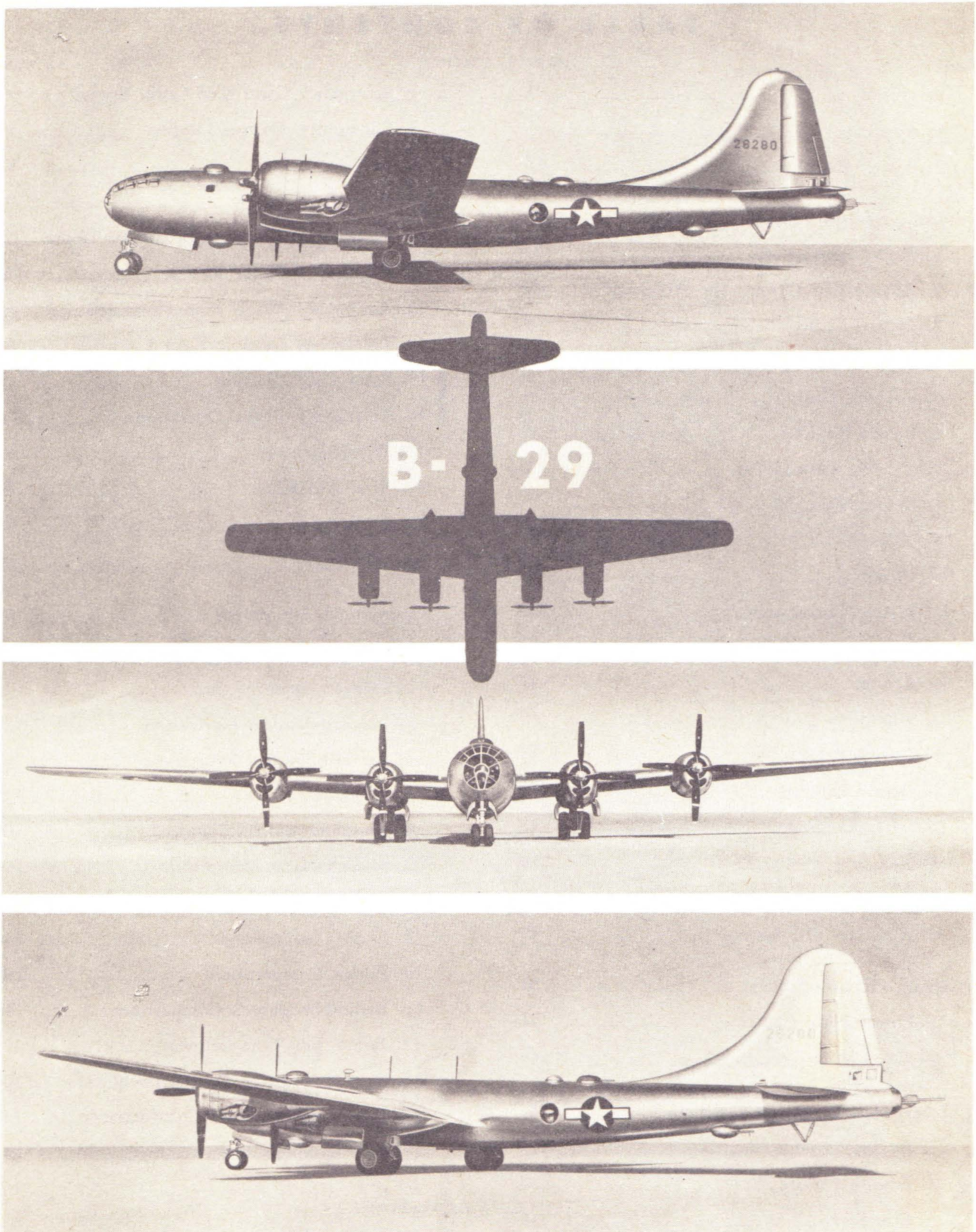


Figure 1 — B-29 Bombardment Airplane

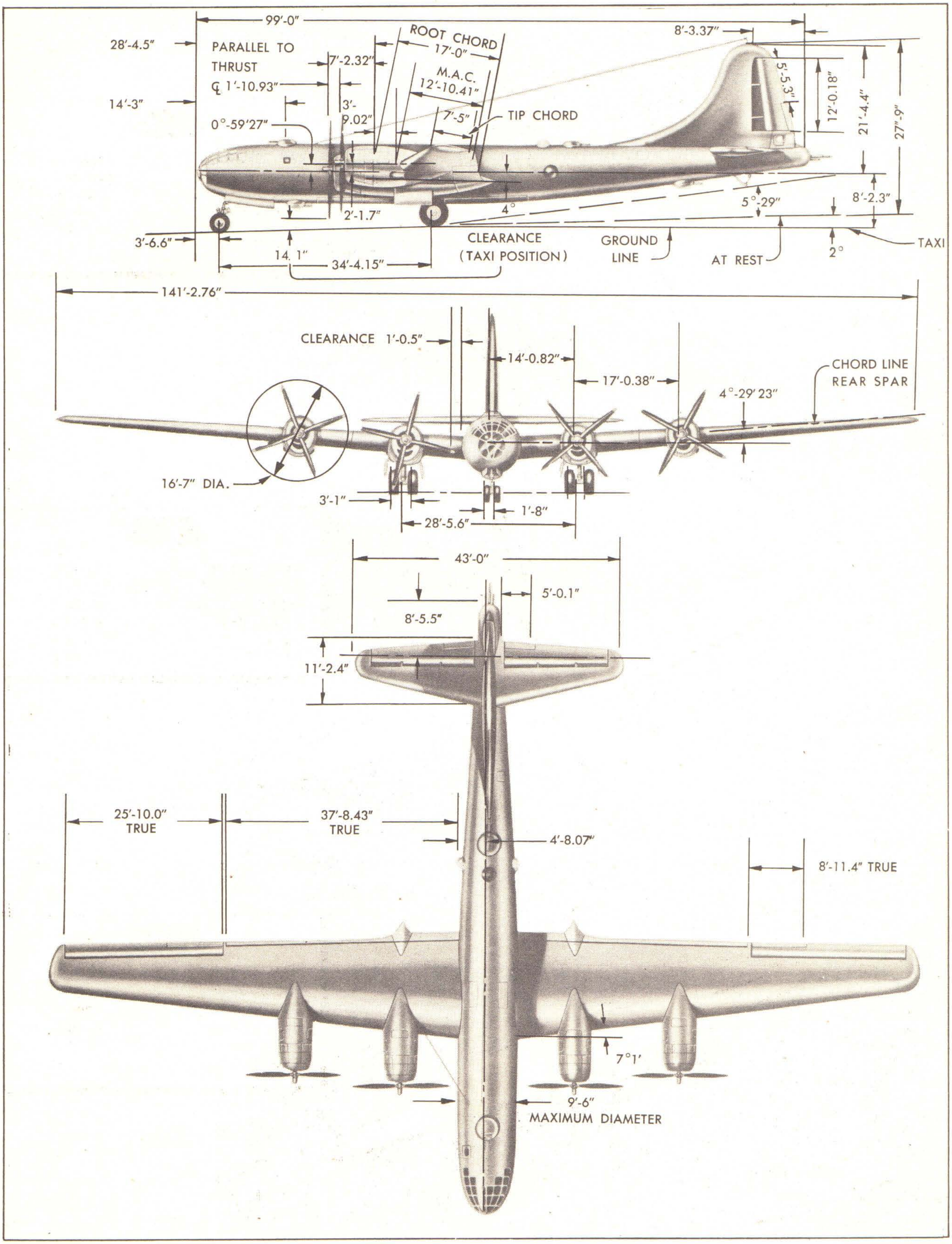


Figure 2 — General Dimensions

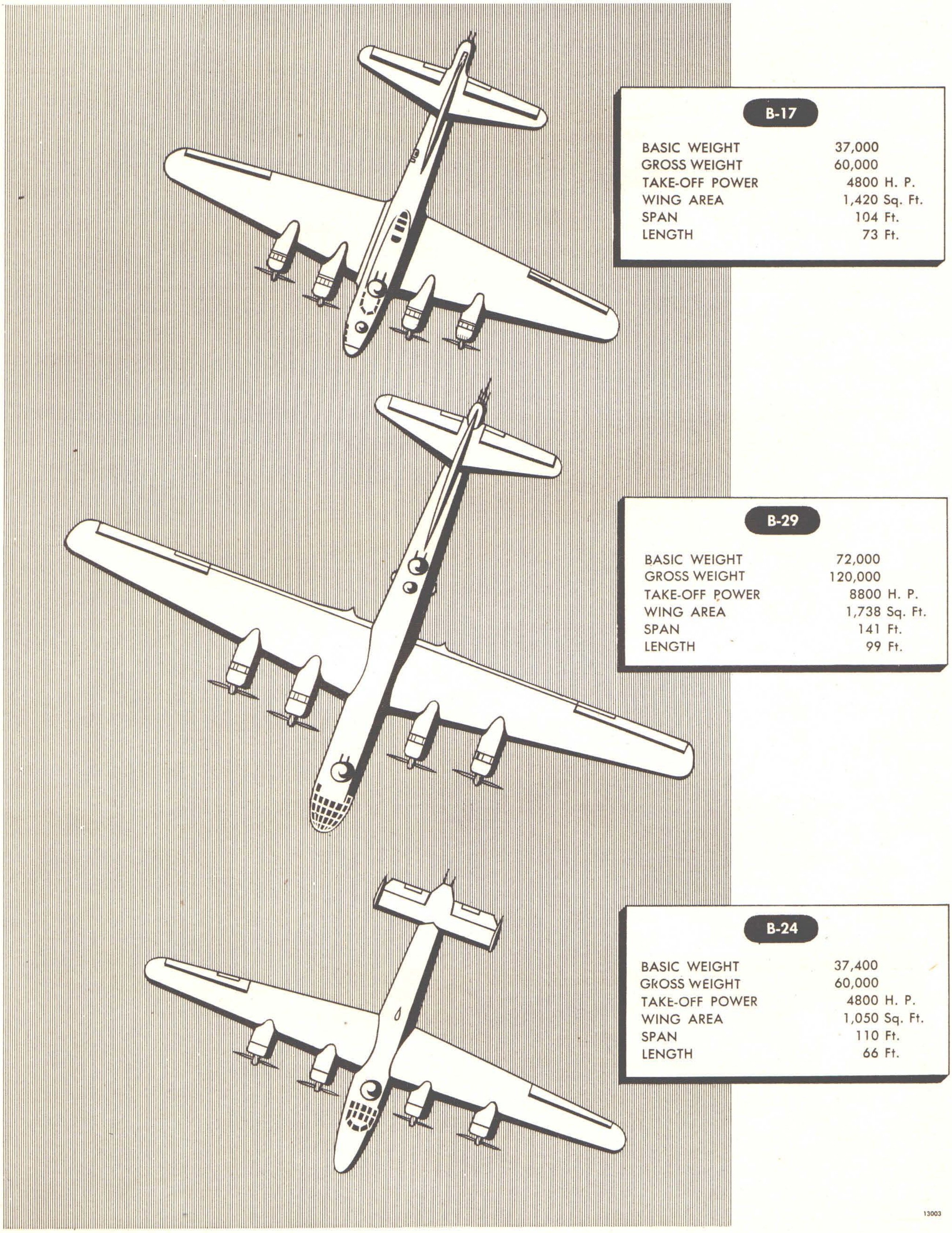
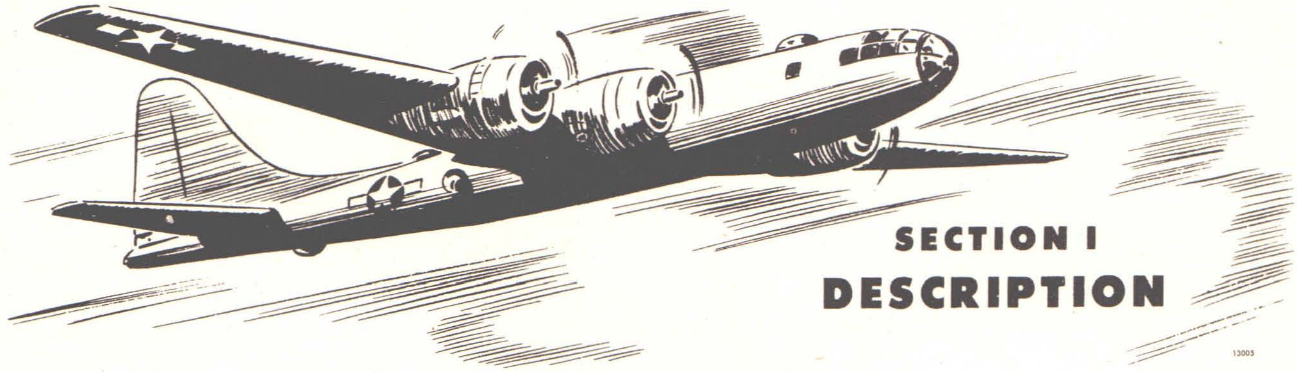


Figure 3 — Comparison B-17, B-29, and B-24



SECTION I
DESCRIPTION

1. AIRPLANE

a. GENERAL.—The B-29 heavy bombardment airplane has a lot in common with the B-17. For instance the B-17 tail was one step in the development of the B-29 tail. Many other features were copied directly. A large amount of experimenting was done with a B-17 to check ideas that were thought of for the B-29; such as dual turbos, and the B-29 stabilizer, elevators, and ailerons. The large propellers on the B-29 are the outgrowth of such experimentation. All of the flight experience that has made the B-17 what it is was built into the B-29. Besides being bigger than the B-17, it is cleaner aerodynamically so it will go farther and perform better. Pilots making transition from B-17 or B-24 to B-29 can get an idea of the differences by referring to the comparison diagram on the opposite page. Their size isn't much different, but the weight and power of the B-29 is twice theirs, and its speed is a good deal more. When it is fully loaded with fuel and oil, it holds as much liquid as a railroad tank car. The designed gross weight is 105,000 pounds; recommended maximum gross weight is 128,000 pounds.

(1) The B-29 is a midwing monoplane with four 2000 horsepower radial engines using four bladed hydromatic propellers. The wingspread is 141′ 3″; the length 99 feet. The overall height is 29′ 6.7″ (taxiing position). The tricycle landing gear, and the tail skid are fully retractable.

(a) FUSELAGE.—The all metal, semi-monocoque type fuselage is divided into main compartments as shown in the diagram, Figure 4. Three of these compartments can be pressurized so as to provide crew comfort even at extreme altitudes. The forward pressurized compartment and the rear pressurized compartment are connected by a tunnel, through which crew members have access to either compartment during flight. The tail gunners' pressurized compartment is separate.

(b) WING.—The wing consists of a center section, two inboard panels, two outboard panels, and two wing tips. Self sealing fuel tanks are installed in the inboard wing structure. Both ailerons have trim tabs. Electrically operated wing flaps form the lower surface of the inboard wing trailing edge.

(c) EMPENNAGE. — The empennage is conventional; including a horizontal stabilizer, elevators with trim tabs, a dorsal fin joining the vertical stabilizer, and the rudder with its trim tab.

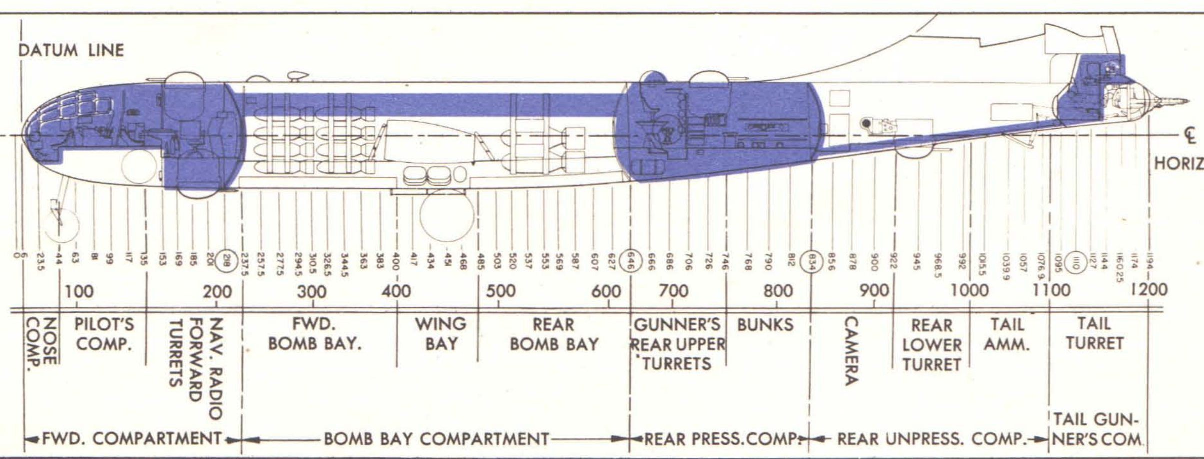


Figure 4 — Pressurized Compartments Diagram

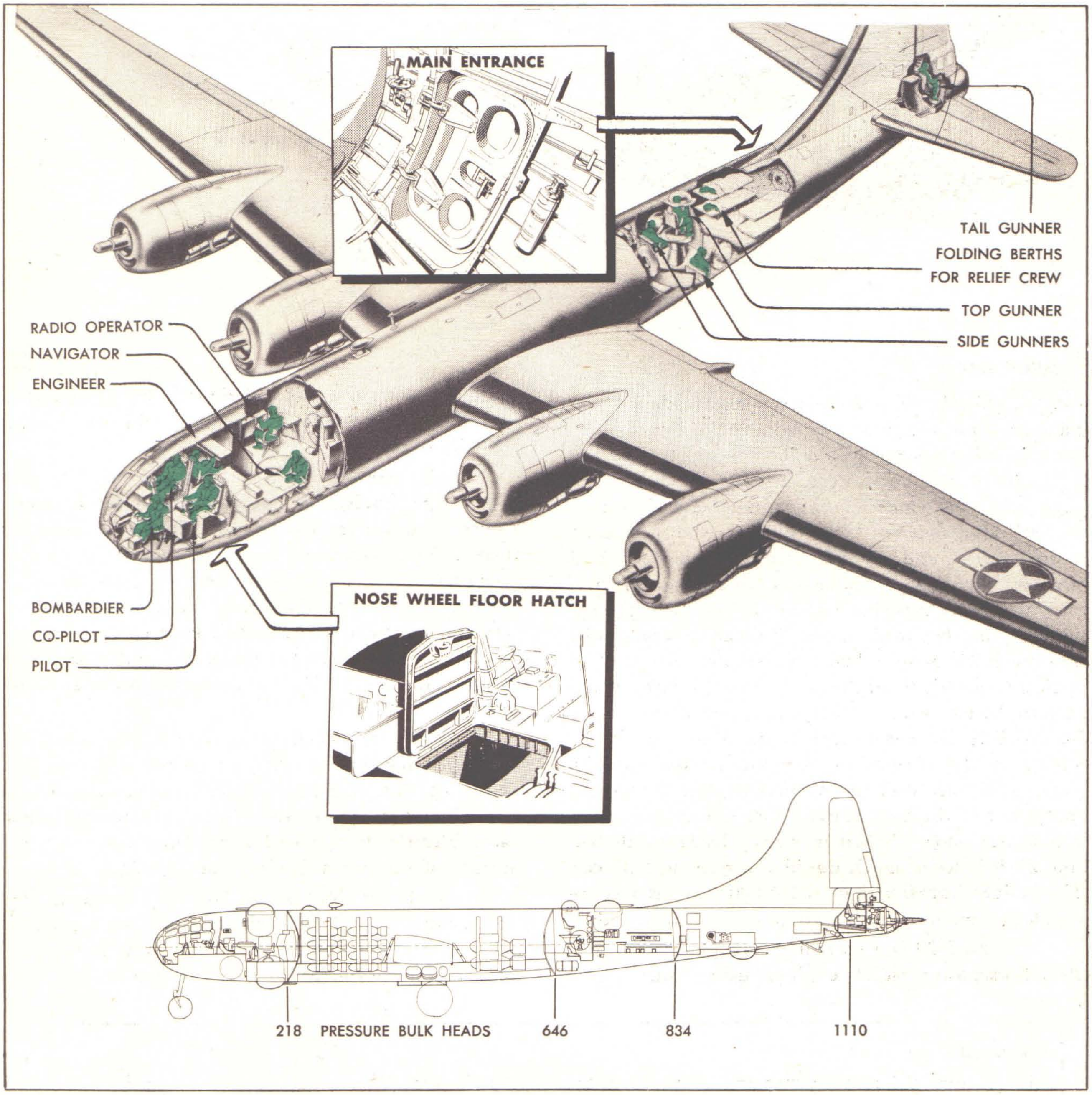


Figure 5 — Crew Stations and Access to Airplane

(2) The normal crew of 6 consists of a pilot, copilot, engineer, navigator, radio operator, and bombardier. The alternate crew of 10 adds a top gunner, two side gunners (one who will be a radar operator), and a tail gunner. Bunks in the rear pressurized compartment will accommodate two relief crew men. The normal crew members do not have to leave their stations to fly the airplane, but there is ample room for moving around when necessary.

(3) The pilot, copilot, engineer, navigator, radio operator, and bombardier enter through the nose wheel well, and up through the floor hatch near the engineer's station. The gunners board the airplane through the main entrance door which is on the right side of the fuselage near the tail.

(a) Exit is normally made through the doors named in the preceding paragraph. Emergency exits are outlined in Section IV.

(4) Shock - mounted, non - magnetic armor plate protects crew members at their stations. In addition, "bullet proof" windows are provided for the pilot, copilot, and tail gunner.

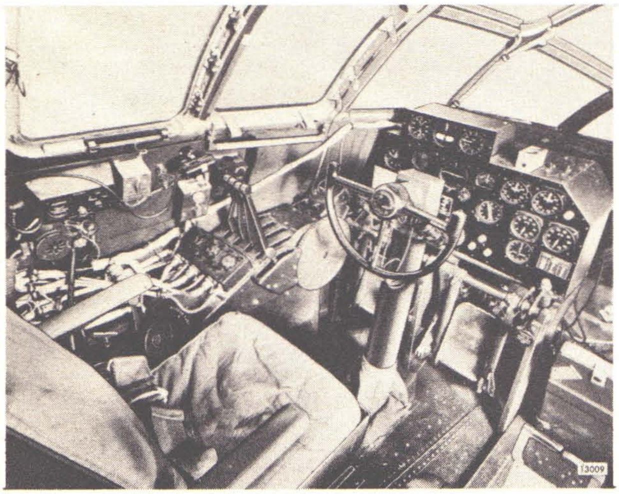


Figure 6 — Pilot's Station

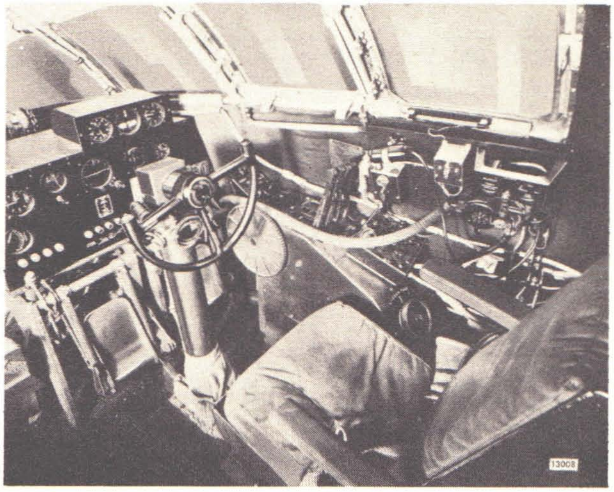


Figure 8 — Copilot's Station

b. FLIGHT CONTROLS.

(1) GENERAL. — The airplane has conventional flight controls.

(a) PILOT'S AND COPILOT'S STATIONS. — The engineer handles most of the power plant, electrical, and basic mechanical operations so the pilot and copilot can concentrate more on flying technique and combat strategy. All three stations have a set of throttles, the override control being at the pilot's station. However, in later models, this override control will not be installed. The turbosuperchargers are all controlled by a single dial knob on the pilot's aisle stand. Although the aisle stand is close by the pilot, it can be reached by the copilot for some operations.

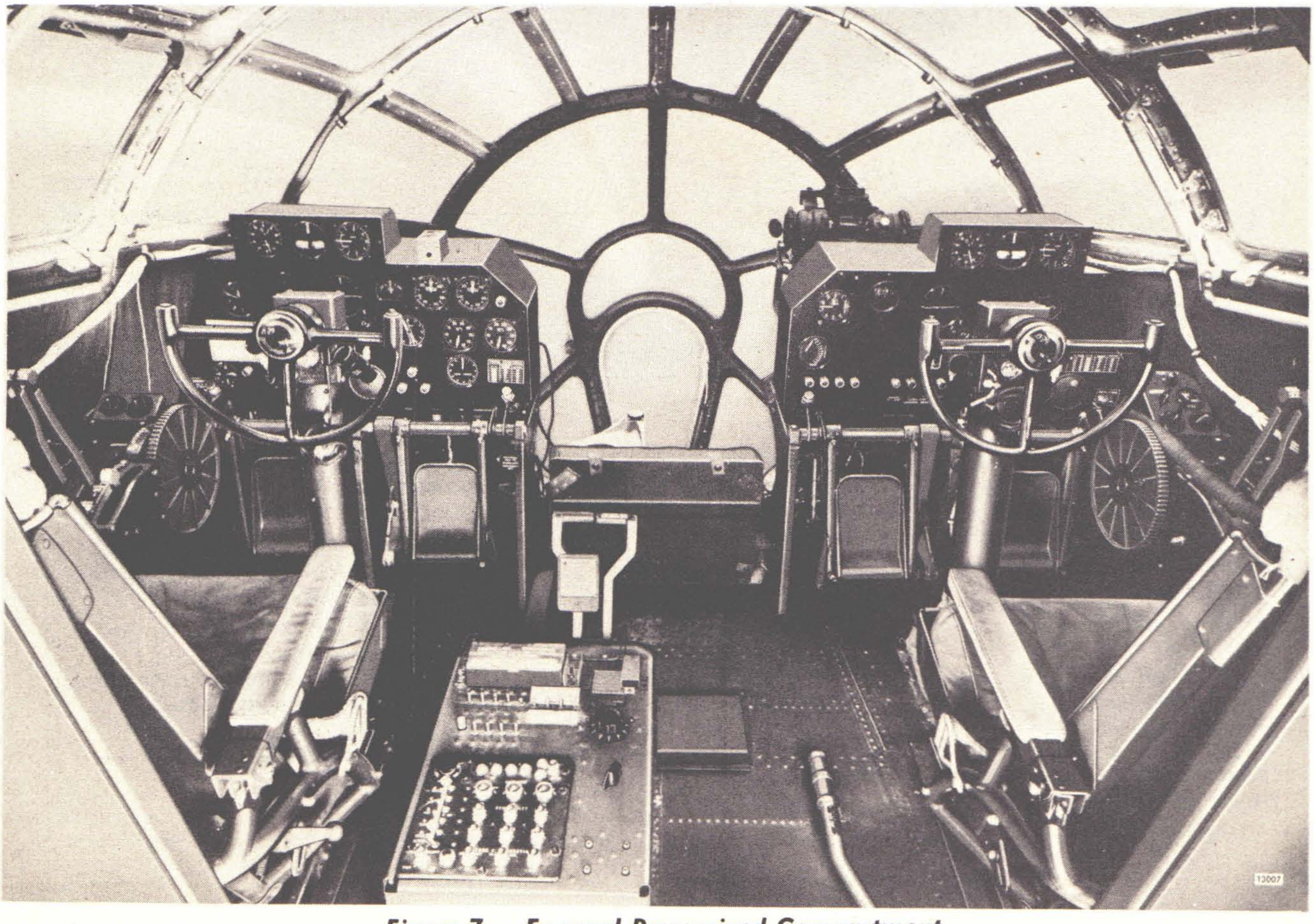
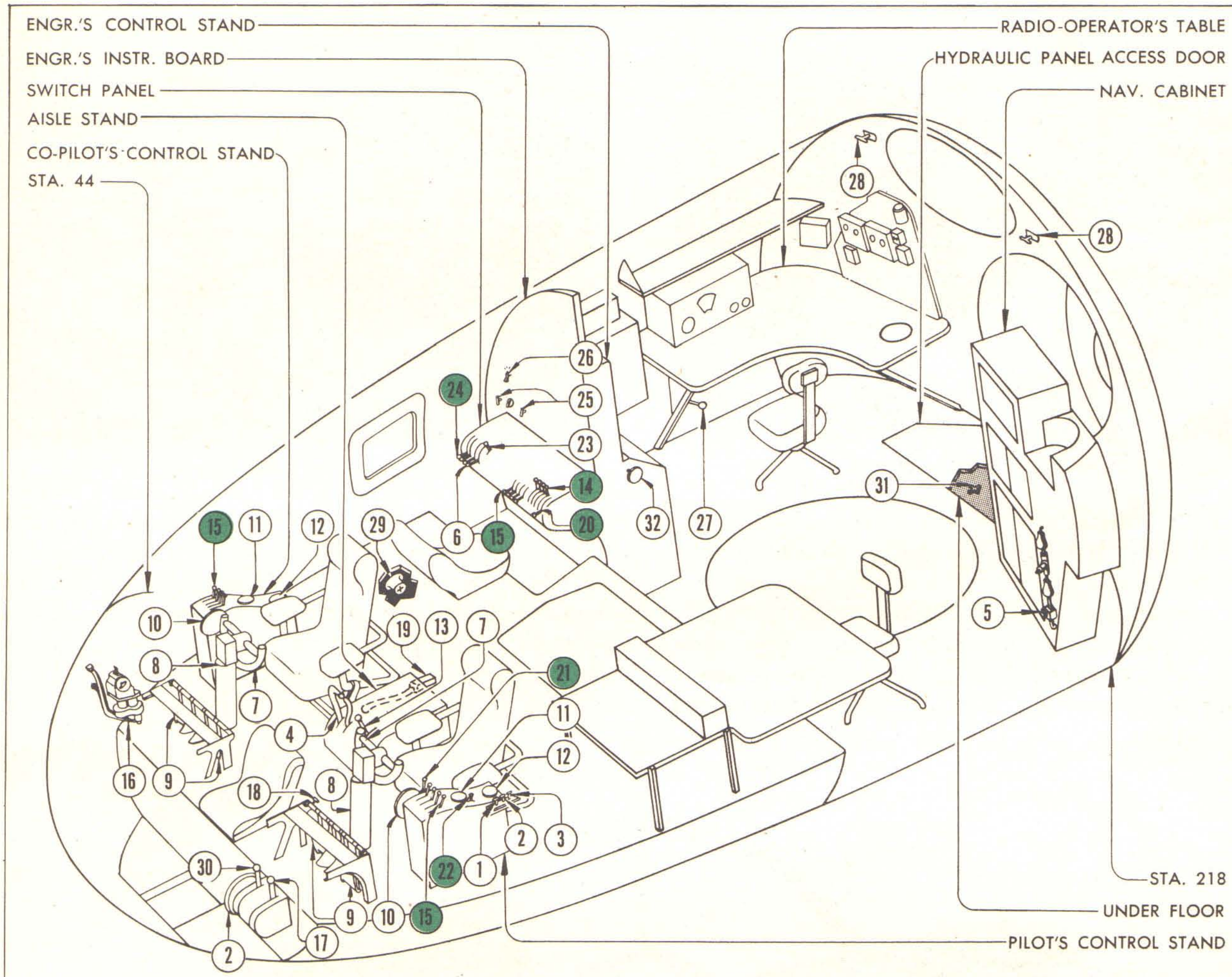


Figure 7 — Forward Pressurized Compartment



CONTROLS

EMERGENCY CONTROLS
1—CABIN AIR PRESSURE RELEASE
2—BOMB RELEASE
3—LANDING GEAR DOOR RELEASE
4—METERING BRAKE VALVE
5—VACUUM SHUTOFF VALVE
6—EMERGENCY CABIN AIR VALVE (2)

FLIGHT CONTROLS
7—AILERON
8—ELEVATOR
9—RUDDER AND BRAKE PEDAL
10—ELEVATOR TRIM TAB
11—AILERON TRIM TAB
12—RUDDER TRIM TAB
13—SURFACE LOCKS

ENGINE CONTROLS
14—MIXTURE (4)
15—THROTTLE (4)

OTHER CONTROLS
16—NOSE GUN SIGHT
17—BOMB RELEASE (BOMBARDIER'S)
18—PARKING BRAKES
19—HYDRAULIC HAND PUMP
20—MIXTURE LOCK
21—THROTTLE LOCK
22—OVERCONTROL
23—VACUUM SELECTOR VALVE
24—TANK SELECTOR (2)
25—FIRE EXTINGUISHER (ENGINE) (2)
26—FILLER VALVE (EMERG. HYD. SYSTEM)
27—TRAILING ANTENNA FAIRLEAD
28—LIFE RAFT (2)
29—CABIN PRESSURE RELIEF VALVE
30—BOMB DOOR RELEASE
31—HYDRAULIC SHUTOFF VALVE (SERVICING)
32—EMERGENCY OXYGEN VALVE

REAR COMPARTMENT CONTROLS (NOT SHOWN)
A1—EMERGENCY BOMB RELEASE AT STA. 646
A2—EMER. CABIN AIR PRES. RELEASE STA. 646
A3—CAMERA SYSTEM SHUTOFF VALVE ⎤
A4—CAMERA SHUTOFF VALVE (3) ⎥ STA. 834
A5—CAMERA REGULATING VALVE ⎦
6—LOWER TURRET GUN SIGHT (2) AT STA. 686
A7—UPPER TURRET GUN SIGHT AT STA. 686
A8—TAIL TURRET GUN SIGHT
A9—EMERGENCY OXYGEN VALVE AT STA. 646 AND STA. 834

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Figure 9 — Manual Controls Location Diagram

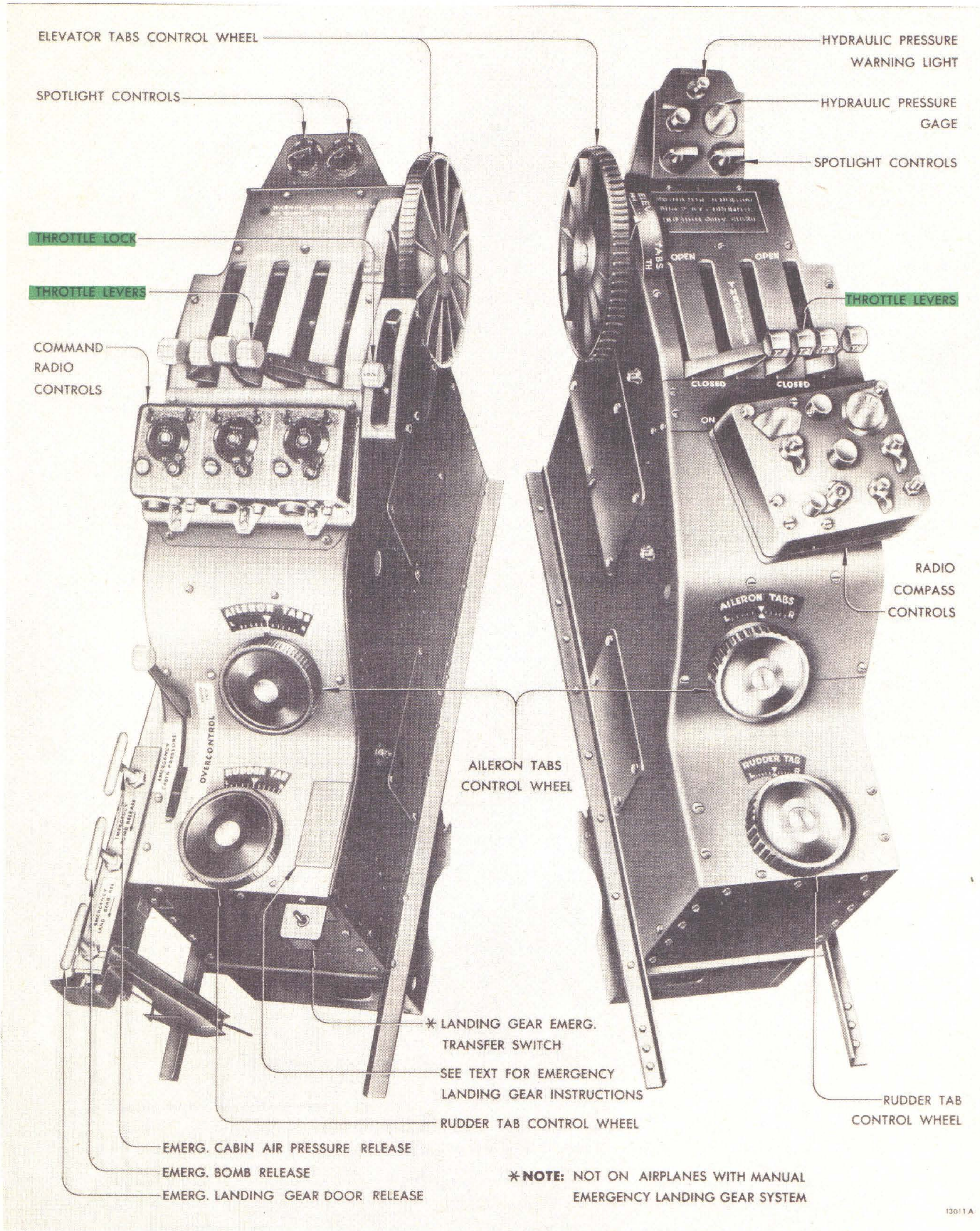
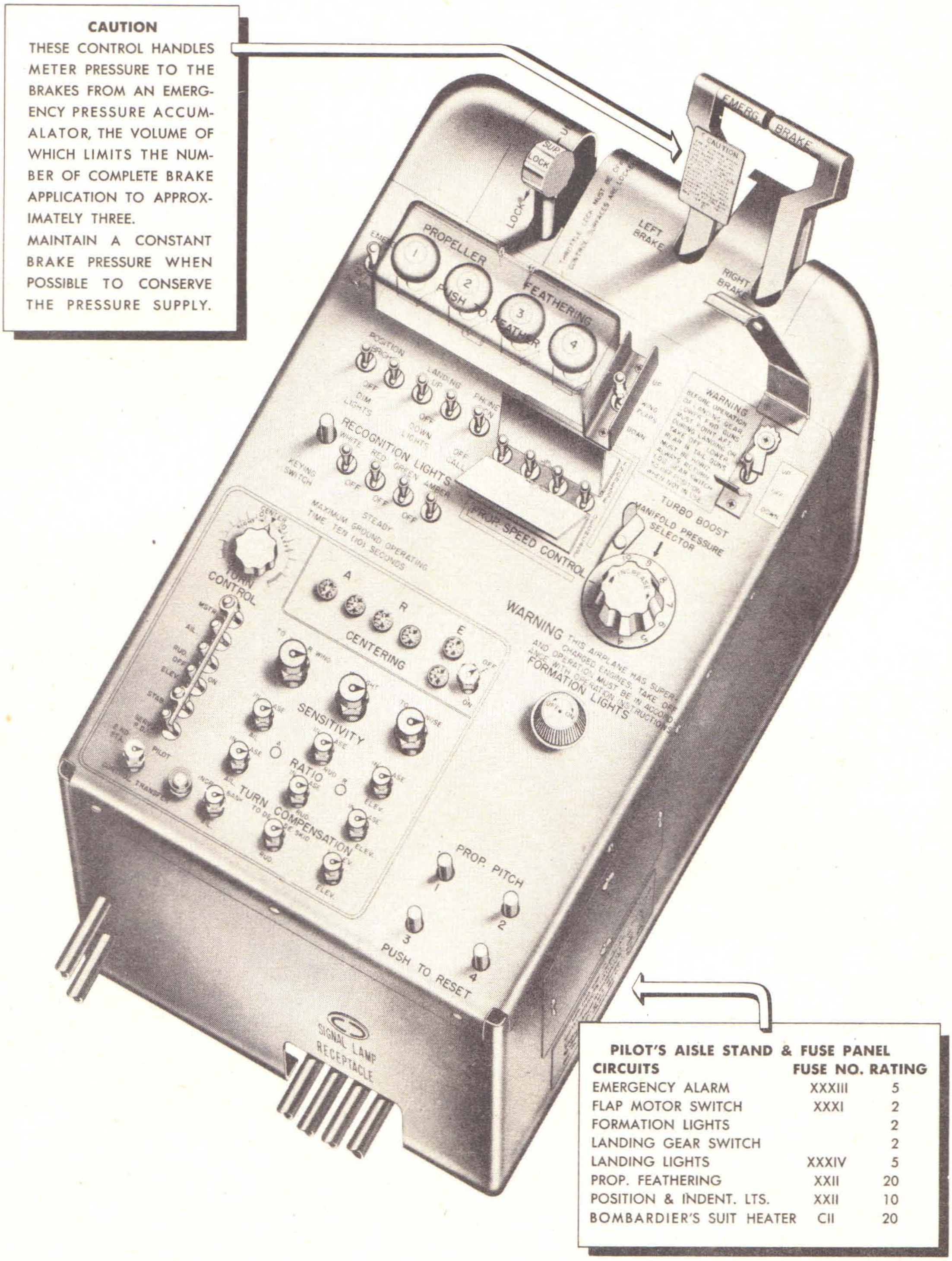


Figure 10 — Pilot's and Copilot's Control Stands

(b) PILOT'S AND COPILOT'S CONTROL STANDS.—Figure 10 shows the pilot's and copilot's control stands. Note that throttle levers and trim tab controls are duplicated.



PILOT'S AISLE STAND & FUSE PANEL

CIRCUITS	FUSE NO.	RATING
EMERGENCY ALARM	XXXIII	5
FLAP MOTOR SWITCH	XXXI	2
FORMATION LIGHTS		2
LANDING GEAR SWITCH		2
LANDING LIGHTS	XXXIV	5
PROP. FEATHERING	XXII	20
POSITION & INDENT. LTS.	XXII	10
BOMBARDIER'S SUIT HEATER	CII	20

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Figure 11 — Aisle Stand

(*c*) AISLE STAND.—A stand is provided in the aisle between the pilot and copilot, allowing each of them easy access to the controls. These controls are: control surface lock lever, emergency brake levers, wing flap control switch, normal landing gear switch, propeller feathering switches, emergency alarm switch, phone call switch, formation light rheostat, position light switches, identification light switches, propeller RPM, propeller pitch circuit breaker resets, A.F.C.E. system controls, and turbo boost selector.

(*d*) ENGINEER'S STATION.—The engineer's station is on the right side of the airplane behind the copilot, facing aft. This places him in close communication at all times with the pilot and copilot and also enables him to check visually all four engines while seated at his station.

Figure 12 — Engineer's Station

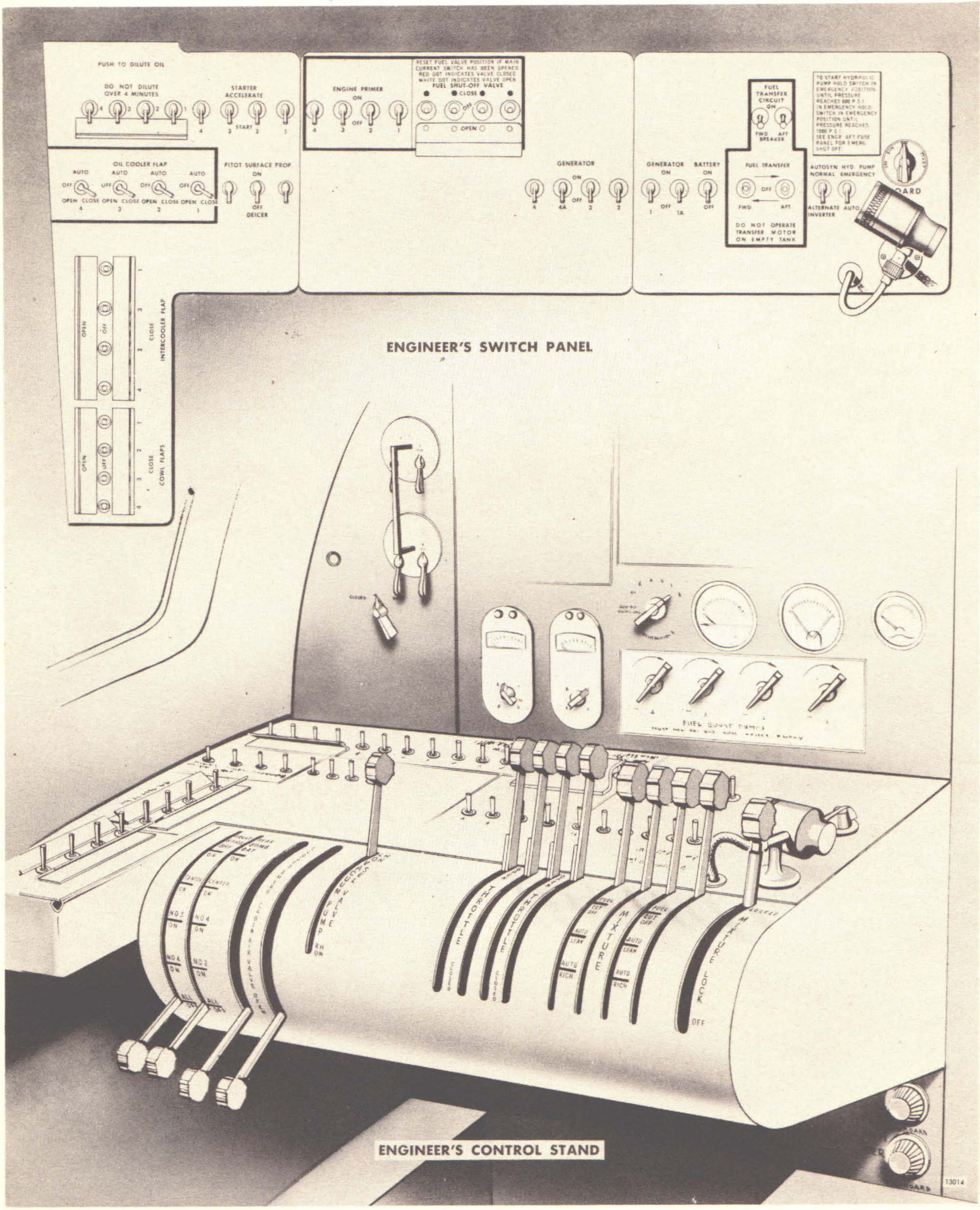

Figure 13 — Engineer's Control Stand and Switch Panel

(*e*) ENGINEER'S CONTROL STAND. — This control stand has controls for the throttles, mixture, fuel transfer, cabin air flow, and vacuum selector. The engineer's switch panel adjoins the control stand.

(f) AILERON, ELEVATOR, AND RUDDER.—The ailerons, elevators, rudder, and their trim tabs have the conventional system of controls.

(g) CONTROL CABLES. — A bus cable connects the right and left aileron cable drums. Each control column will operate only one aileron if the bus cable is broken. However, if the control cable from one column is broken, the cable from the other control column will still operate both ailerons. Elevator and rudder cables are conventional.

(2) TRIM TABS. — The aileron trim tabs are geared to move when the ailerons move. The shape of the wing airfoil contour is such that the part covered by the ailerons has a hollow on top and is full at the bottom. If the control cables get broken, the ailerons would ordinarily trim down because of this shape. To avoid this, the trim tabs are rigged down one inch at the trailing edge, which tends to trim the ailerons to more nearly neutral if the cables are shot.

(3) WING FLAPS.—The wing flaps are actuated electrically, and controlled by a switch on the pilot's aisle stand. A position indicator is on the copilot's instrument panel. If the flaps are not lowered between 20 and 30 degrees before take-off, the warning horn will blow when the throttles are opened ¾ or more. In emergency the flaps can be operated by use of the portable electric motor which is normally stowed on top of the midwing section within the fuselage. This motor can be plugged into the nearby electric receptacle and engaged with the adjacent torque connection. To operate the portable motor as mentioned, either the landing gear power transfer switch (pilot's control stand) or the emergency circuit switch (battery solenoid shield) must be in the "EMERGENCY" position. Wing flap operation requires power produced by systems shown in figure 15.

MINIMUM POWER SUPPLY	OPERATION
Extending Wing Flaps (IN THE AIR)	A.P.P., 1 generator and battery or 2 generators and battery.
Retracting Wing Flaps (IN THE AIR)	A.A.P. and battery; or one generator and battery.
AND IN COMBINATION WITH LANDING GEAR OPERATION AS BELOW:	
Normal Landing (extending flap and landing gear) or when Retracting Flaps and Landing gear together.	A.P.P., 2 generators and battery; or 3 generators and battery.

Figure 15 — Wing Flap Landing Gear Power Chart

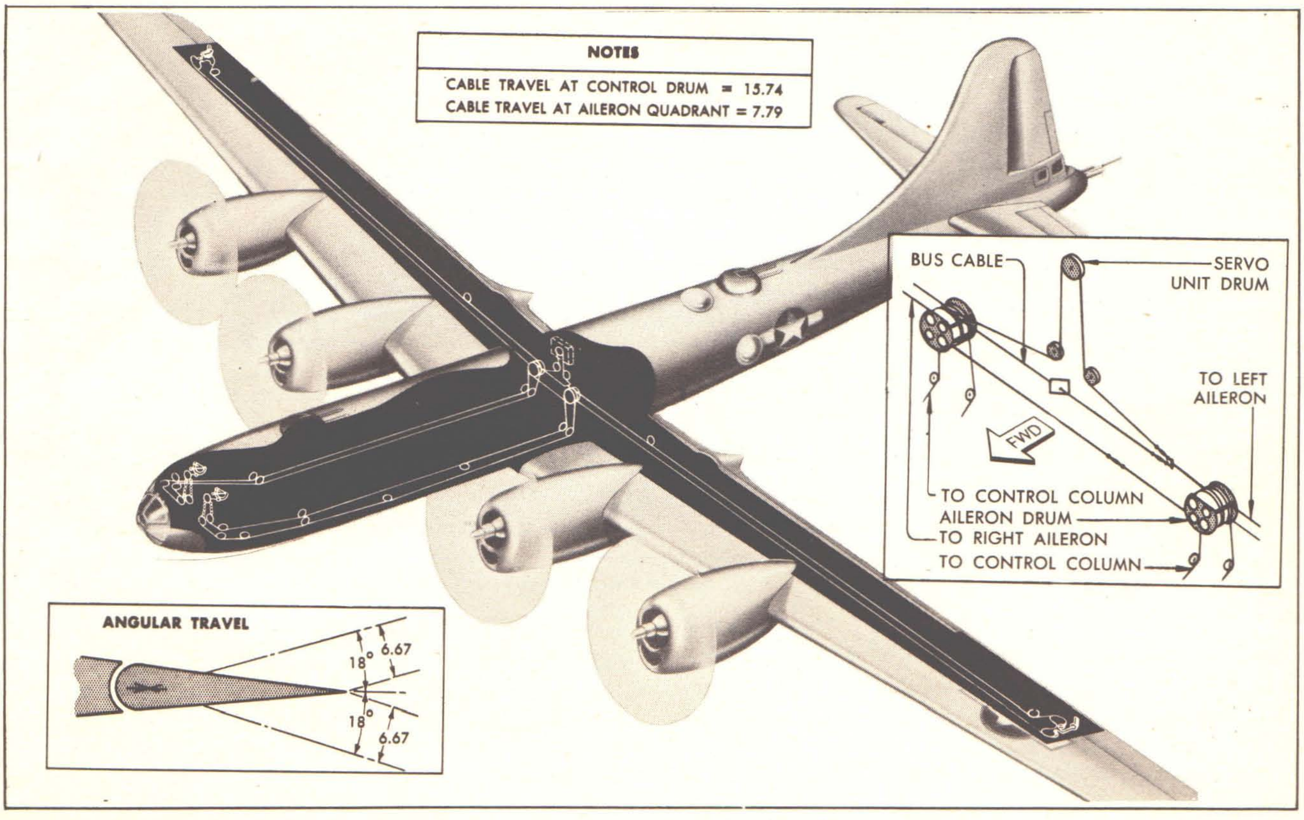

Figure 14 — Aileron Control System

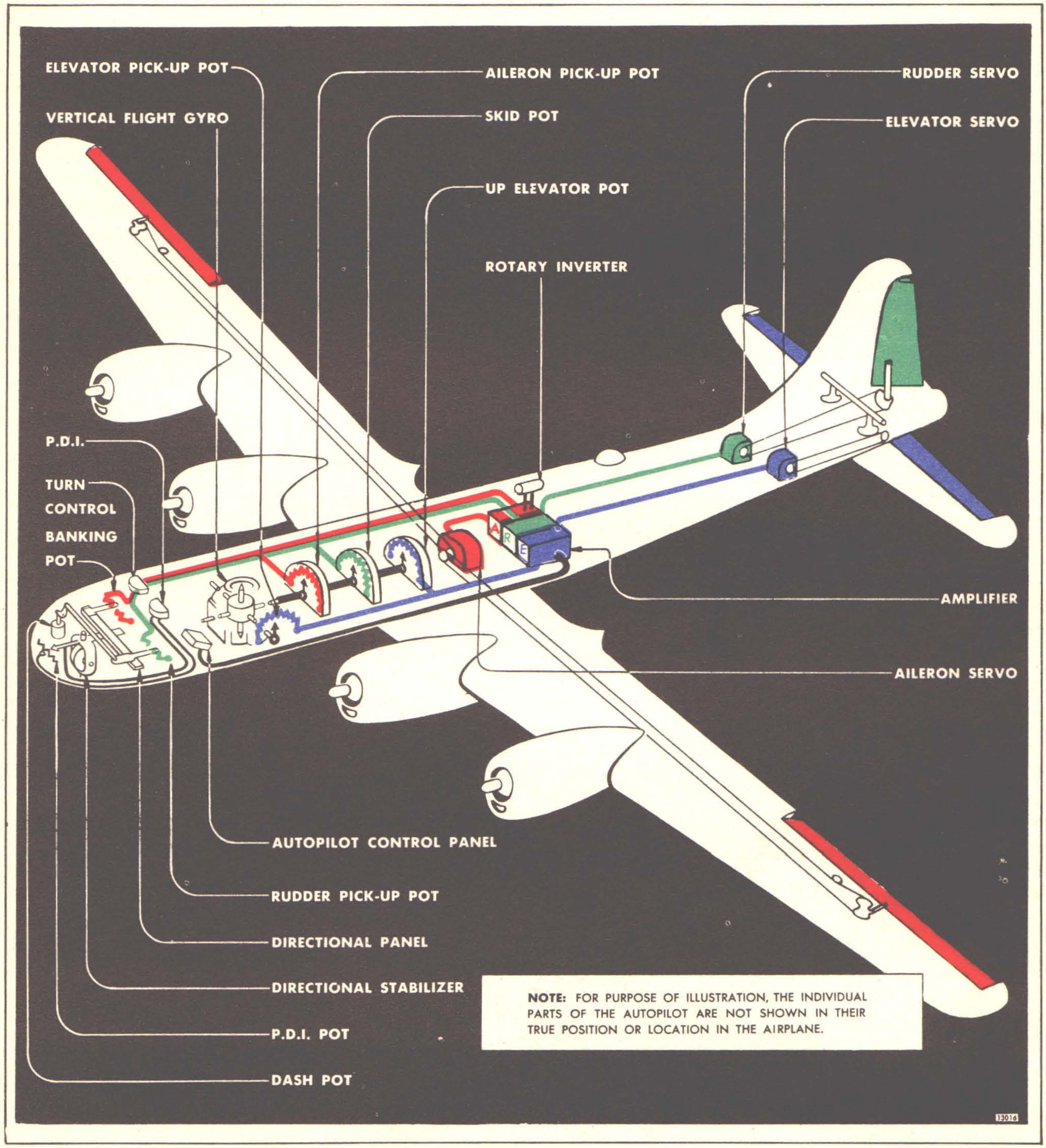

Figure 16 — Automatic Pilot (Schematic Diagram)

(4) AUTOMATIC PILOT.—The C-1 autopilot is an electromechanical robot which automatically flies the airplane in straight and level flight, or maneuvers it in response to fingertip controls operated manually by the pilot or bombardier.

(a) DESCRIPTION. — Various separate units are electrically interconnected to operate as a system. A general understanding of the system can be gained from the illustration. Note that in this diagram the connecting lines do not represent wires, but rather serve to connect related units. The diagram is schematic throughout.

(b) CONTROLS.—The main controls are on the pilot's aisle stand, as are the tell-tale lights which indicate when servo motors are in operation. Additional controls are on the bombsight.

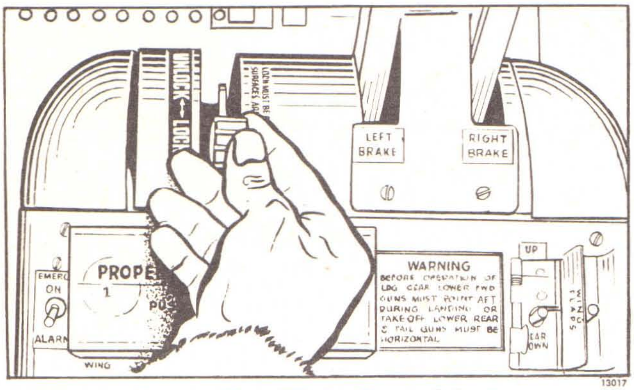

Figure 17 — Flight Control Locks

(5) FLIGHT CONTROL LOCKS. — A lever on the aisle stand is provided for locking all control surfaces. This lever simultaneously locks the throttles in the closed position. The locking pins are spring loaded and the surfaces cannot lock in case of locking cable failure during flight.

c. LANDING GEAR.—The landing gear consists of two main gear units, a nose wheel unit, and a tail skid. In normal operation all of the units will extend or retract at the same time. In emergency operation, on early airplanes, each main gear and the nose gear must be put down separately by an individual switch. Later airplanes have a manual emergency landing gear system. The tail skid has no emergency operation provision. Landing gear warning lights are on the copilot's instrument panel.

(1) MAIN LANDING GEAR. — The right and left main landing gear units are built into the inboard nacelles. Each unit incorporates an air-oil shock strut and dual wheels with expander - tube type hydraulic brakes.

(2) NOSE WHEEL.—The nose gear has an air-oil shock strut, a shimmy damper, and has dual wheels without brakes. This gear can swivel 68 degrees either side from neutral. Within 15 degrees, either side of neutral, the gear will automatically center itself, so the wheels will be aligned when retracting and when extended for landing. There is no lock for the nose wheel.

(3) TAIL SKID.—The retractable tail skid normally operates in conjunction with the landing gear, and serves to prevent damage to the airplane in a tail-down take-off or landing.

(4) BRAKES. — The hydraulic brakes are controlled by toe pressure on either the pilot's or copilot's rudder pedals.

(a) EMERGENCY BRAKES. — For emergency use, there are two brake levers on the aisle stand.

(b) PARKING BRAKE. — The parking brake is a button-type pull handle on the pilot's rudder pedal stand. To lock the parking brake, depress the foot brakes and pull out the parking brake handle. To release, depress the foot brakes and push back the parking brake handle as far as it will go.

d. HYDRAULIC SYSTEM.—The hydraulic system is for the brakes only. The required system pressure is 800—1000 PSI. For storing up pressure, there are two hydraulic accumulators, one normal, and one emergency. A relief valve keeps system pressure from exceeding 1075 PSI.

(1) ELECTRIC PUMP—An electric pump keeps the pressure up in the hydraulic system. An automatic pressure switch turns the pump on at 800 PSI and off at 1000 PSI. The pressure switch won't operate when the system pressure is below 200 PSI.

(2) PUMP SWITCH.—The engineer can increase system pressure by closing the momentary contact switch on his instrument panel if the automatic pressure switch fails to turn on the hydraulic pump.

(3) GAGES AND WARNING LIGHTS.—A pressure gage (normal) and a warning light (normal) are on the copilot's control stand; the warning light flashes on at 625 PSI. On the engineer's instrument panel are a pressure gage (normal), a pressure gage (emergency), and a warning light (emergency), which flashes on at 900 PSI.

(4) FILLER VALVE SWITCH.—On the engineer's panel is the filler valve for the emergency accumulator. The valve handle normally is "CLOSED," but is put at "OPEN" to charge the accumulator.

(5) HAND PUMP.—On the floor at the copilot's left is the hydraulic system hand pump. It should be used well in advance of the time the brakes are to be applied if hand pumping is needed to build up hydraulic system pressure.

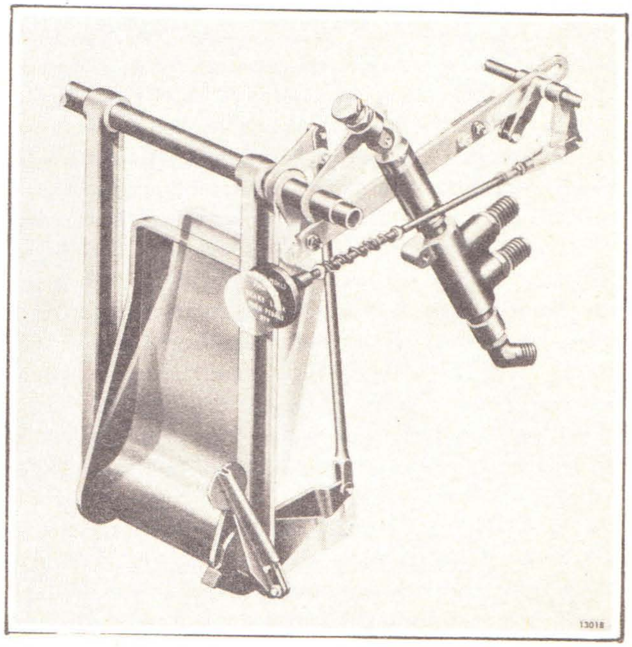

Figure 18 — Parking Brake Handle

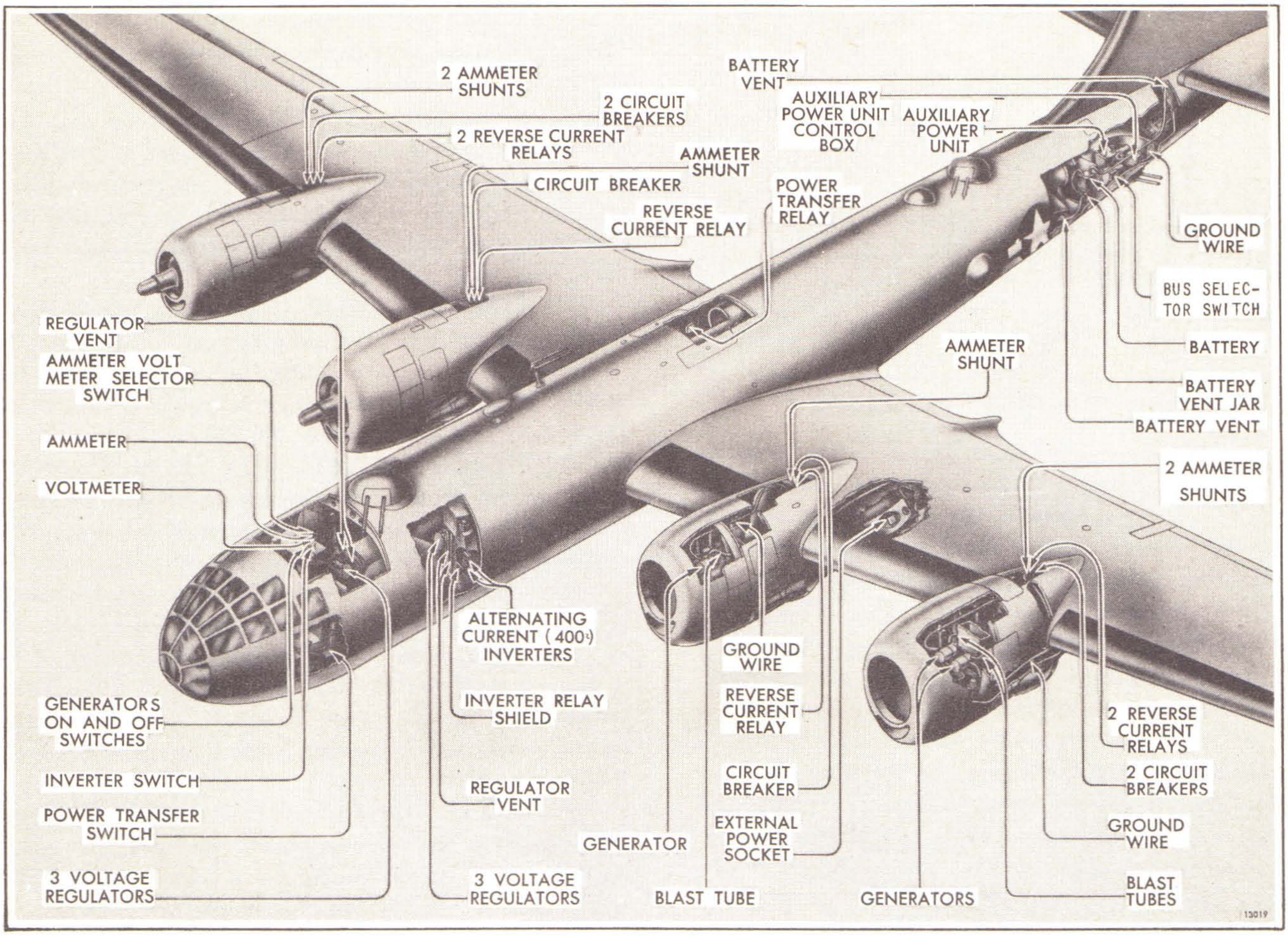

Figure 19 — A.C.-D.C. Power Supply

e. ELECTRICAL SYSTEM. — Electrical power is supplied by 6 engine-driven, 28 volt, 300 ampere generators (2 on each outboard engine, one on each inboard engine), a 24 volt 34 ampere hour battery, a 28 volt 200 ampere auxiliary generator (put-put), and two inverters. The engine driven generators (switches on engineer's panel) cut in at 1100 RPM and reach maximum output at 1375 RPM. Either inverter (switch on engineer's panel) can be used to supply 26 volt alternating current for the autosyn instrument (flap position indicator) and 115 volt alternating current for the radio compass, the flux gate compass, and the turbo regulators. AFCE operates on 115 volt AC from its own inverter. The B-29 has the conventional position lights, recognition lights, and formation lights. The landing lights (switch on aisle stand) turn on when they are extended from the under side of the wing. Wheel well spotlights controlled from the engineer's panel illuminate the landing gear for a visual check at night.

(1) AUXILIARY POWER PLANT.—The auxiliary power plant (put-put) isn't supercharged; above 10,000 feet its voltage output decreases as altitude increases. At very high altitudes, the put-put will run only if the mixture is leaned out. In normal operation the put-put is used to supply power for starting, take-off, and landing.

(2) BUS SELECTOR SWITCH — The emergency switch on the battery solenoid shield (near the put-put) transfers power to the emergency bus for emergency landing gear motors and portable electric motor.

(3) EXTERNAL POWER.—The external power receptacle is in the nose wheel well.

(4) FUSES.—Seventeen fuse panels throughout the airplane are provided, of which only four, the nacelle solenoid panels, are inaccessible in flight. Six more are inaccessible in supercharged flight; the nose gear solenoid shield, forward and aft bomb door motor solenoid shields, inverter relay shield, battery solenoid shield, and tail skid junction shield. The seven remaining fuse panels are accessible under all conditions: bombardier's fuse panel, aisle stand fuse shield, engineer's forward fuse panel, engineer's aft fuse panel, radio compass junction shield, station 646 fuse shield and turret junction shield. A replacement for each active fuse is mounted inside its fuse shield cover. Each nacelle solenoid panel has extra fuses mounted on the panel side.

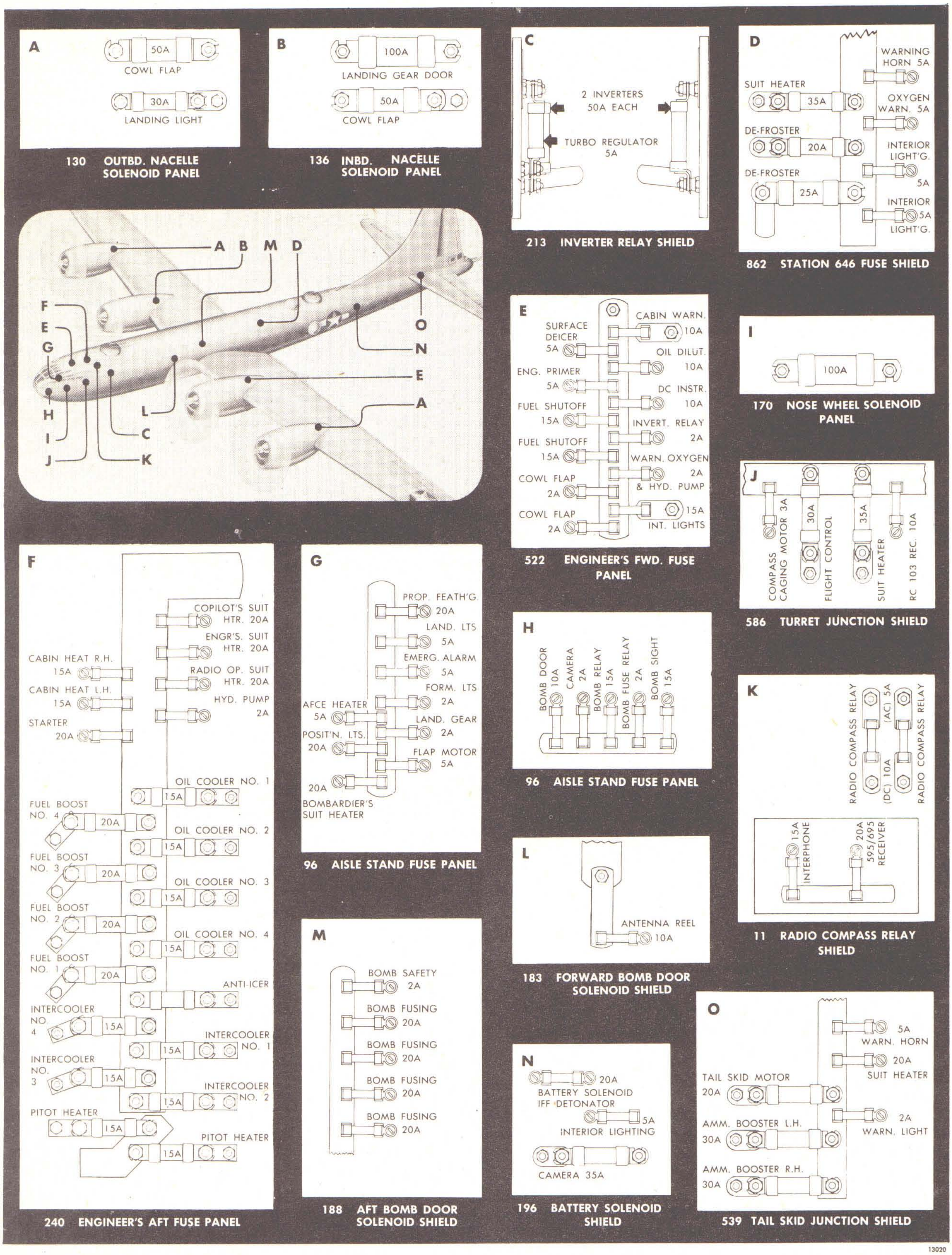

Figure 20 — Fuse Location Diagram

"FIG. 21 HAS BEEN DELETED BY REVISION."

(5) SPARE LAMPS.—Spare lamps for A-6, A-7, A-9, B-7, C-4 and C-5 lights are stowed in a holder in the navigator's cabinet. A spare lamp panel in the top of the tail gun enclosure also holds two spare lamps for either the C-4 spotlight or the A-7 light. A spare lamp for the copilot's compass is on the copilot's instrument panel.

(6) INVERTER AUTOMATIC CHANGEOVER RELAY.

(a) An automatic changeover relay is provided on later airplanes to assure uninterrupted AC power. If the 115 volt AC inverter output voltage drops to between 30 and 70 volts, or upon starting the engine, if the main inverter fails to build up in eight seconds the spare inverter will automatically cut in.

(b) Two operation indicator lights are on the engineer's switch panel and two identical lights are on the pilot's panel. With the normal inverter operating, both indicator lights will be off. Upon failure of the normal inverter, one light at each station comes on. Upon failure of both normal and alternate inverters, both lights at both stations come on. A spring loaded inverter switch on the "On-Off-Momentary-On" type is on the engineer's panel and is protected by a spring loaded guard. An AC voltmeter, 0-150 volts, is on the engineer's instrument panel. An indicator light circuit breaker and an inverter circuit breaker are also on the engineer's switch panel.

(c) Only the main inverter should be used during all normal conditions. However, before flight, the engineer should check first the spare inverter and then the normal inverter with the manual switch and note the indication on the AC voltmeter. From 100 to 120 volts is marked as the correct operating range, since the turbo control units will become inoperative when the voltage drops to about 95. When the normal inverter is turned on, the indicator lights will denote any malfunction of the normal inverter or both inverters, and if the lights show both are inoperative, a check should be made by switching manually to the spare inverter, since a defect in either the signal relay or the changeover relay may also be indicated by the lights.

WARNING

When testing, first test spare inverter, then start main inverter. Do not switch from main to spare except as emergency over-ride.

(d) If the above warning is not adhered to, it is possible to put the spare inverter into operation when the switch is in the "Normal-On" position thus eliminating the automatic changeover feature and indicating failure of the normal inverter. The heater unit in the changeover relay must have two minutes or more to cool after it is heated up before pushing the inverter switch to test the spare inverter. If sufficient time is not allowed the heater unit in the changeover relay will still be warm enough to maintain contact thereby keeping the spare inverter in operation when the manual inverter switch is pushed back to the normal position.

(7) SUIT HEATER OUTLETS. — At each crew station there is a 24 volt heater receptacle and heostat.

(8) INTERIOR LIGHTING.—Fluorescent lamps with filters are on the pilot's, copilot's, bombardier's and engineer's instrument panels. The lamps are controlled by rheostats on the bombardier's instrument panel and on the pilot's, copilot's and engineer's auxiliary panels. Each rheostat has three positions: "START," "ON" and "DIM." The copilot's compass is internally lighted; a rheostat is on the copilot's auxiliary panel. An adjustable spotlight with a self-contained rheostat is at the following stations: pilot's, copilot, navigator, radio operator, top gunner, right gunner, left gunner, and tail gunner. The radio operator, engineer, navigator, and bombardier are provided with a table light. An extension lamp is near the auxillary power plant. Dome lights are installed throughout the airplane.

(9) EXTERIOR LIGHTS.

(a) RECOGNITION LIGHTS. — Conventional recognition lights are provided. The KEY-OFF-STEADY switches are on the aisle stand.

(b) POSITION LIGHTS.—The wing tip position (red and green) lights are controlled by a switch and fixed resistor on the aisle stand. The switch allows choice of "BRIGHT," "OFF" and "DIM" operation. A similar control is provided for the tail (white) light.

(c) FORMATION LIGHTS. — There are nine formation (blue) lamps; three in the upper surface of the fuselage, and three in the upper surface of each wing, aft of the rear spar. The rheostat is on the aisle stand.

(10) INTER-AIRCRAFT SIGNAL LAMP. — A power receptacle for an inter-aircraft signal lamp is on the rear of the aisle stand. The trigger switch control is integral with the lamp.

(11) ELECTRICAL EQUIPMENT FAILURE.—If electrical equipment begins to fail, the generators and inverters should be checked first to make sure the system is not going dead. For example, fluorescent lights going out or interphone going dead may be the first indication that generator switches are off or that the put-put is not "on the line." Then, the fuse or the circuit breaker can be checked.

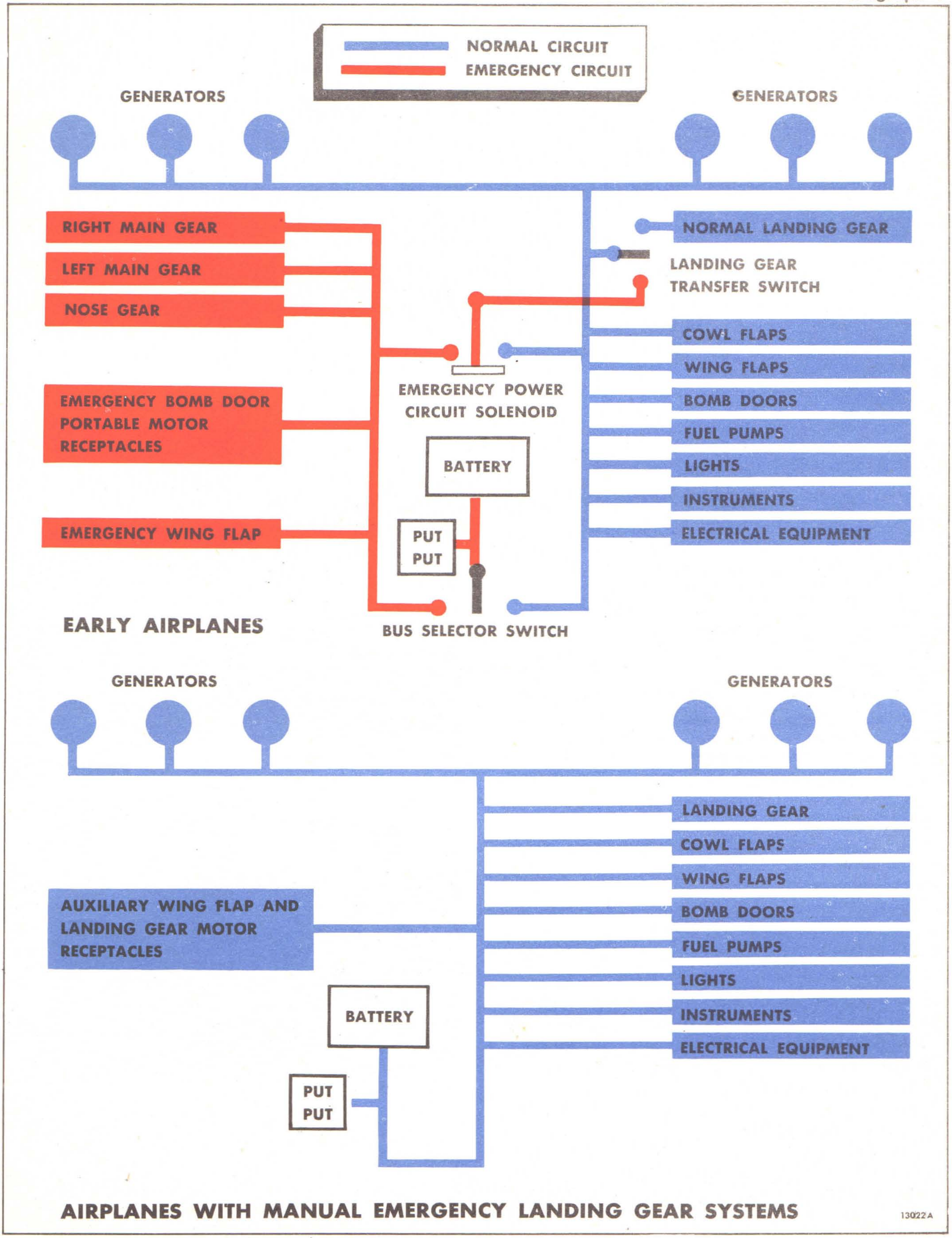

Figure 22 — B-29 Distributing System (Schematic Diagram)

OPERATING CONDITION	HORSEPOWER (NOMINAL)	R.P.M.	MANIFOLD PRESSURE	MIXTURE CONTROL	FUEL FLOW (NOMINAL—G.P.H. PER ENGINE)	MAXIMUM CYLINDER HEAD TEMPERATURE
TAKE-OFF (5 MIN.)	2200	2800	49	AUTO RICH	290	260
RATED POWER (CLIMB)	2000	2400	43.5	AUTO RICH	250	248
RATED POWER (LEVEL CONT.)	2000	2400	43.5	AUTO RICH	250	248
CRUISE	1750	2300	39	AUTO RICH	200	248
CRUISE	1450	2200	35	AUTO RICH	160	240
CRUISE	1170	2100	31	AUTO LEAN	110	232
LONG RANGE CRUISING	950	2000	28 ± 2	AUTO LEAN	95	232
	850	1800	28 ± 2	AUTO LEAN	81	232
	750	1600	28 ± 2	AUTO LEAN	72	232
	600	1400	28 ± 2	AUTO LEAN	62	232
MILITARY POWER AT 25,000 FT. IS 2200 HP AT 2600 RPM AND 47.5 IN. HG.						
FOR INFORMATION ON FUEL CONSUMPTION, POWER SETTINGS, MAXIMUM RANGE, ETC., SEE CRUISE CONTROL SECTION OF "STANDARD PROCEDURES FOR FLIGHT ENGINEERS."						

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Figure 23 — Engine Rating Chart

2. POWER PLANT.—The B-29 is powered by four radial, 18 cylinder Wright engines, type R3350-(23 or 23A). Hamilton full-feathering propellers rotate clockwise when viewed from the rear; the shaft reduction ratio is .35. The carburetor is a Chandler-Evans automatic, type 58-CPB. Each engine has a Jack & Heintz combination inertia and direct cranking starter. Vacuum pumps, one for each engine, furnish vacuum for the cameras, de-icer boots, and instruments. Either inboard pump can be used for vacuum (selector valve on engineer's control stand). The other three pumps provide pressure for the de-icer boots.

a. TEMPERATURE LIMITS—

Condition	Cylinder Head	Oil In
Ground Operation	260°C (500°F)	95°C (203°F)
Prior to Take-Off	220°C (428°F)	85°C (185°F)
Take-Off Power	260°C (500°F)	95°C (203°F)
Military Power	260°C (500°F)	95°C (205°F)
Rated Power (continuous	248°C (475°F)	85°C (185°F)
70 per cent Rated Power (continuous)	232°C (450°F)	85°C (185°F)

b. FUEL AND OIL SPECIFICATIONS.—Fuel: AN-F-28, grade100-130. Oil: AN- VV-0-446 *a*, grade 1120.

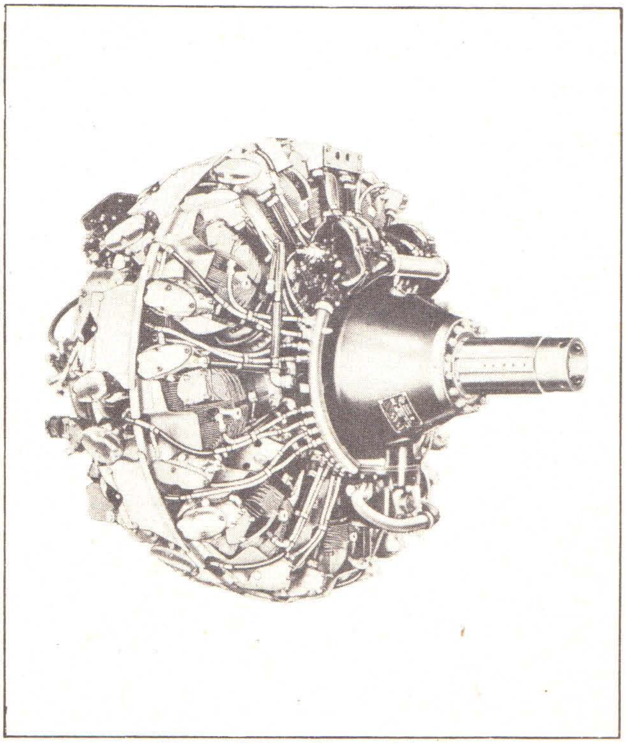


Figure 24 — Power Plant

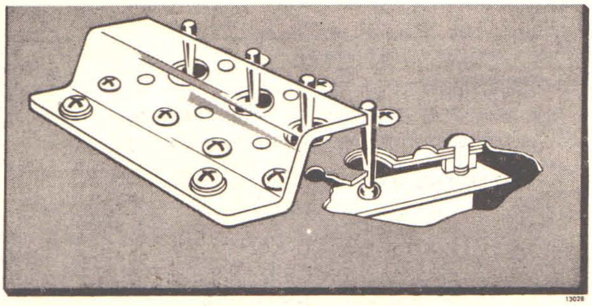


Figure 25 — Fuel Shut-Off Valve

c. FUEL SYSTEM.—Each engine has an independent fuel supply carried in wing tanks. Extra fuel can be carried in releasable tanks in the bomb bays. Some models have a wing center section tank. There are tank safety switches high on the port wall of each bomb bay. Turned off when bomb bay tanks are carried, the safety switches disconnect the bomb release mechanism and prevent an unintended release of the tanks. Fuel can be transferred between rear bomb bay tanks and front bomb bay tanks; between rear bomb bay tanks and tank 3 or 4; between front tanks and tank 1 or 2; and across the centerline of the airplane from engines 1 or 2 to either 3 or 4. Fuel can be transferred between a wing center section tank and any other tank. Fuel tank selector valve levers and fuel transfer pump switches are at the engineer's station. The hourly transfer capacity at sea level with both transfer pumps operating is 1500 gallons; at 30,000 feet it is 500 gallons per hour. With one transfer pump operating, the hourly capacity is 900 gallons at sea level and 300 gallons at 30,000 feet. Engine primers and booster pumps are controlled from the engineer's station. Some models have separate toggle switches for "ON-OFF" control of the booster pumps; other models have the "ON-OFF" switch incorporated in each booster pump rheostat. "ON-OFF" switches for the fuel shut-off valves are on the engineer's panel.

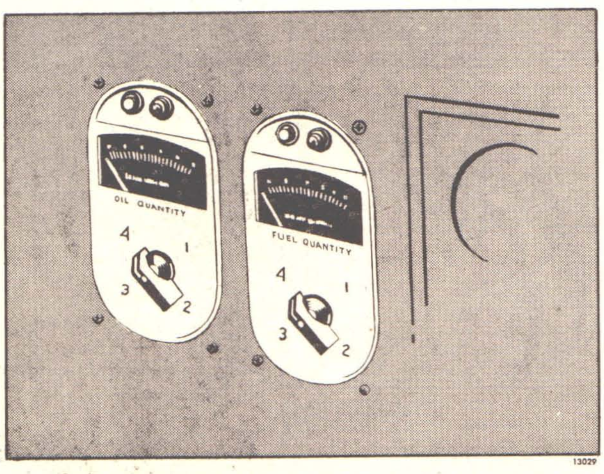


Figure 26 — Gage Selector Knobs

d. OIL SYSTEM.—Each engine has an independent oil supply. An oil cooler is in the oil OUT line between the engine and the oil tank. Each oil cooler has an automatic temperature regulator controlled by a switch on the engineer's panel. Oil dilution switches are on the engineer's panel.

e. THROTTLE CONTROLS.—Throttle control levers are at the engineer's control stand as well as at the pilot's and copilot's. On some models, the pilot has a lever by which he can take over the control of the engineer's throttle levers. Throttles will automatically open to full if the engine control cables are severed.

f. MIXTURE CONTROL. — Carburetor mixture control levers are on the engineer's control stand.

g. PROPELLER CONTROLS. — Four momentary contact switches are on the pilot's aisle stand for propeller RPM control. They operate in conjunction with amber signal lights on the copilot's instrument panel. The signal lights indicate the limit of governor travel in either direction. Magnetic push-button switches are on the pilot's aisle stand for propeller feathering. The switches pop out when feathering is complete. The buttons can be pulled out by hand to stop feathering. The buttons are held in to unfeather. Transparent hinged guards over the switches prevent accidental feathering. The propeller anti-icer switch is on the engineer's panel. Two anti-icer rheostats, one for outboard propellers, the other for inboard propellers, on the engineer's stand can be used to vary the flow of anti-icer fluid from 2 to 5 gallons per hour.

h. CARBURETOR AIR TEMP. CONTROLS.—Carburetor air temperatures are controlled by momentary contact (intercooler) switches on the engineer's panel.

i. SUPERCHARGER CONTROL. — On the pilot's aisle stand is the control unit for the superchargers. Four adjusting screws permit the correlation of manifold pressures to a single dial setting. A dial stop prevents dial rotation into the emergency power range beyond 8; the dial stop is released by pressure to the right.

j. COWL FLAP CONTROLS.—Cowl flap controls are momentary contact switches on the engineer's panel. Cowl flap position indicators are on the engineer's panel. The warning horn blows steadily with gear down, cowl flaps open more than 15 degrees, and throttles more than ¾ open.

k. IGNITION CONTROLS.—The ignition switches are on the engineer's panel.

l. STARTER CONTROLS. — Momentary contact starter switches are on the engineer's panel. Each switch has three positions: "OFF", "ACCELERATE", and "START."

m. FIRE EXTINGUISHER CONTROLS.—The fire extinguisher selector knob is at the engineer's station. There are two pull-handles for the discharge of CO_2.

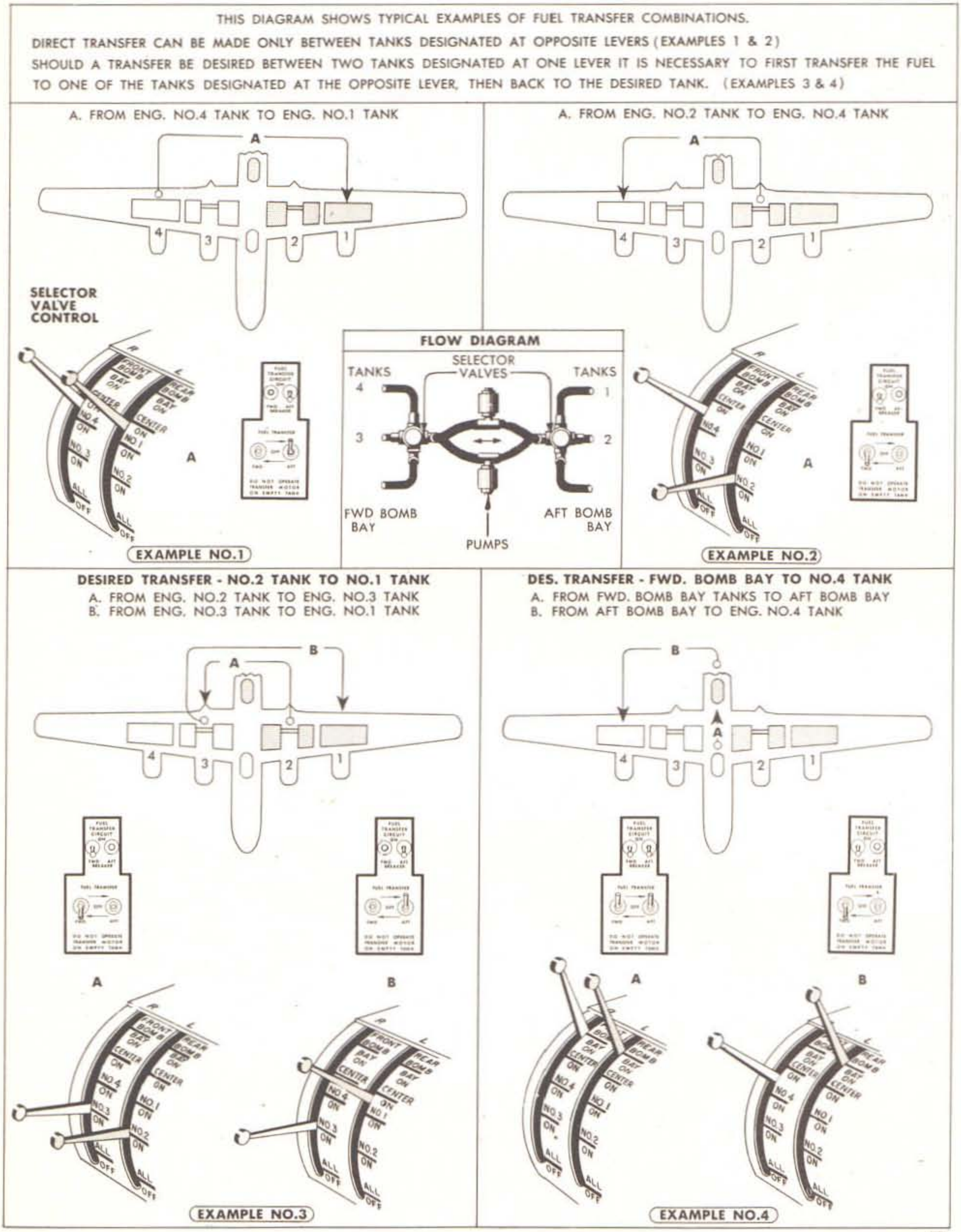


Figure 27 — Fuel Transfer Operation Diagram

THIS DIAGRAM SHOWS TYPICAL EXAMPLES OF FUEL TRANSFER FROM CENTER TANK USING BOTH PUMPS. THE AFT BOMB BAY TANKS ARE CONNECTED TO THE LEFT SIDE SELECTOR VALVE, AND THE FORWARD BOMB BAY TANKS ARE CONNECTED TO THE RIGHT SIDE VALVE. (SEE EXAMPLES 5 AND 6).

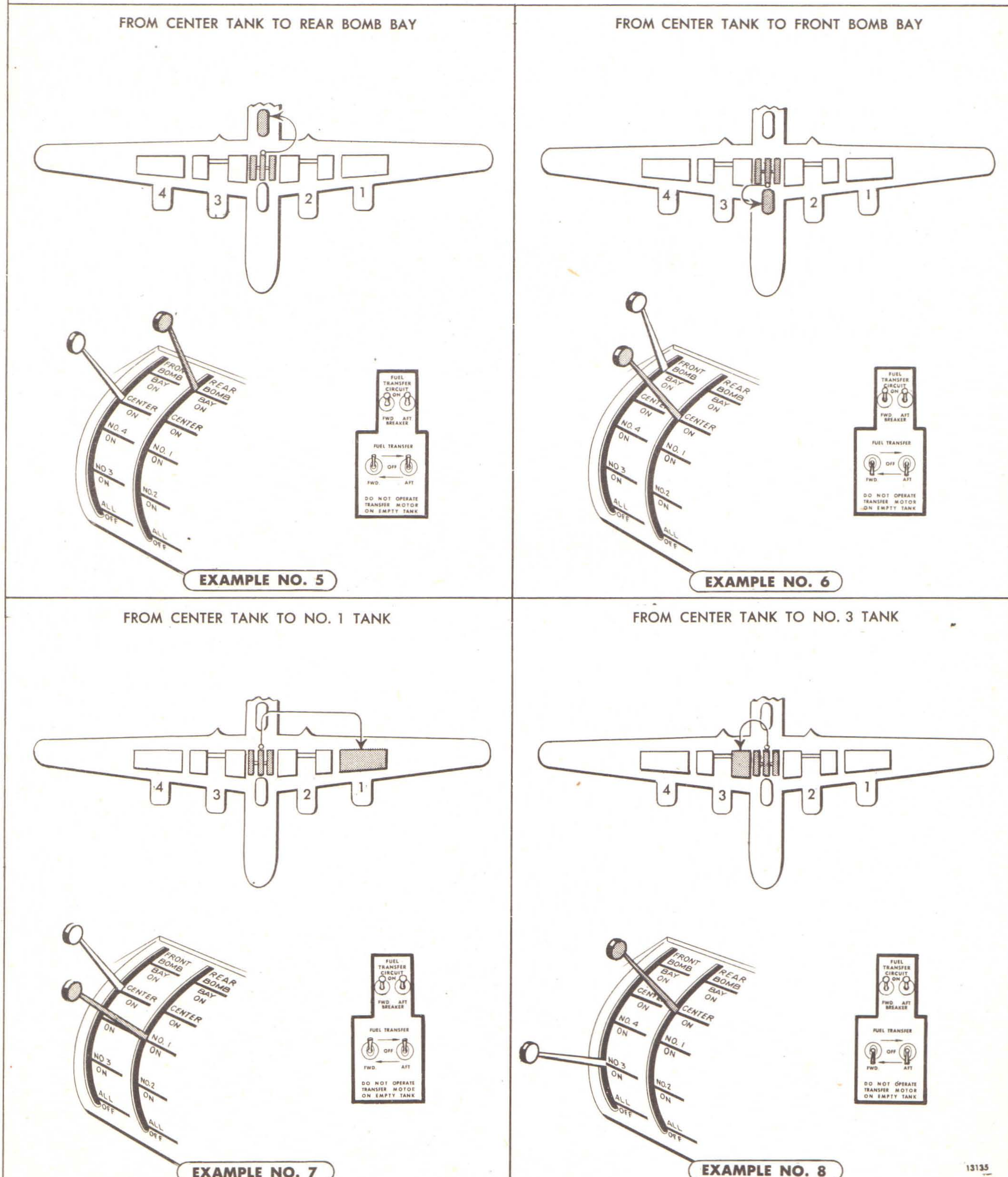


Figure 27 A — Fuel Transfer Operation Diagram

n. TRAPPED UNAVAILABLE FUEL.—When doing extreme maneuvers or making a steep landing approach with low fuel quantities, residual fuel is trapped in the tanks, and can cause one or more engines to cut out because of lack of fuel.

(1) With the airplane fuselage centerline in a 20° nose down position, 268 gallons of fuel are trapped and made unavailable to each inboard engine, and 105 gallons are unavailable to each outboard engine. At a 15° angle, 190 gallons are unavailable to each inboard engine, and 70 gallons are unavailable to each outboard engine.

(2) Eleven gallons of fuel are trapped in each tank, with the airplane at rest on the ground, and cannot be picked up by the booster pumps.

(3) The residual fuel quantities in the tanks for various flight attitudes is shown in the following tabulations.

RESIDUAL FUEL IN WING TANKS WHEN FLYING WITH WINGS LEVEL

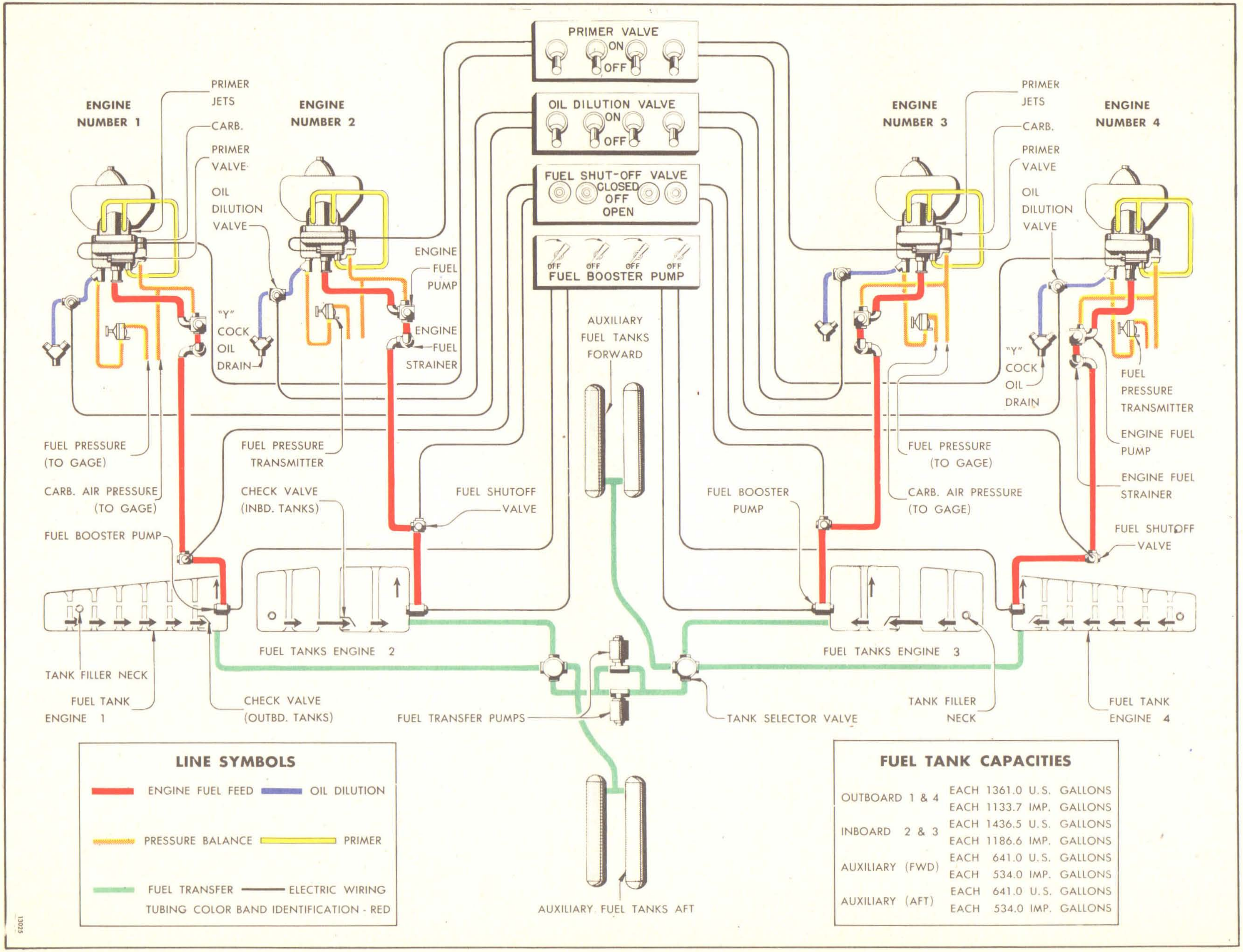
FLIGHT ATTITUDE	TANKS 1 AND 4	TANKS 2 AND 3
Body CL 4° up	21 gals. ea.	17 gals. ea.
Body CL 2° up	18 gals. ea.	17 gals. ea.
Body CL 0°	18 gals. ea.	23 gals. ea.
Body CL 2° down	18 gals. ea.	37 gals. ea.
Body CL 4° down	21 gals. ea.	55 gals. ea.
Body CL 6° down	27 gals. ea.	71 gals. ea.
Body CL 8° down	33 gals. ea.	86 gals. ea.

RESIDUAL FUEL IN CENTER TANKS WHEN FLYING WITH WINGS LEVEL

FLIGHT ATTITUDE	B29A CENTER SECTION TANKS	B29 CENTER SECTION TANKS	BOMB BAY TANKS
Body CL 2° up	0 gals.	17 gals.	3 gals. ea.
Body CL 4° up	1 gal.	24 gals.	9 gals. ea.
Body CL 0°	0 gals.	11 gals.	0 gals. ea.
Body CL 2° down	4 gals.	13 gals.	3 gals. ea.
Body CL 4° down	14 gals.	28 gals.	9 gals. ea.
Body CL 6° down	25 gals.	57 gals.	16 gals. ea.

RESIDUAL FUEL QUANTITIES FOR VARIOUS FLIGHT ATTITUDES WITH EITHER WING 2½° DOWN

FLIGHT ATTITUDE	TANK 1 Gals.	TANK 2 Gals.	TANK 3 Gals.	TANK 4 Gals.
Body CL 4° up	21	17	17	21
Body CL 2° up	18	18	16	18
Body CL 0°	18	32	14	18
Body CL 2° down	18	50	24	18
Body CL 4° down	21	72	38	21
Body CL 6° down	28	99	43	26
Body CL 8° down	36	121	51	30



FUEL TANK CAPACITIES

OUTBOARD 1 & 4	EACH 1361.0 U.S. GALLONS EACH 1133.7 IMP. GALLONS
INBOARD 2 & 3	EACH 1436.5 U.S. GALLONS EACH 1186.6 IMP. GALLONS
AUXILIARY (FWD)	EACH 641.0 U.S. GALLONS EACH 534.0 IMP. GALLONS
AUXILIARY (AFT)	EACH 641.0 U.S. GALLONS EACH 534.0 IMP. GALLONS

Figure 28 — Fuel System Flow Diagram (Early Airplanes)

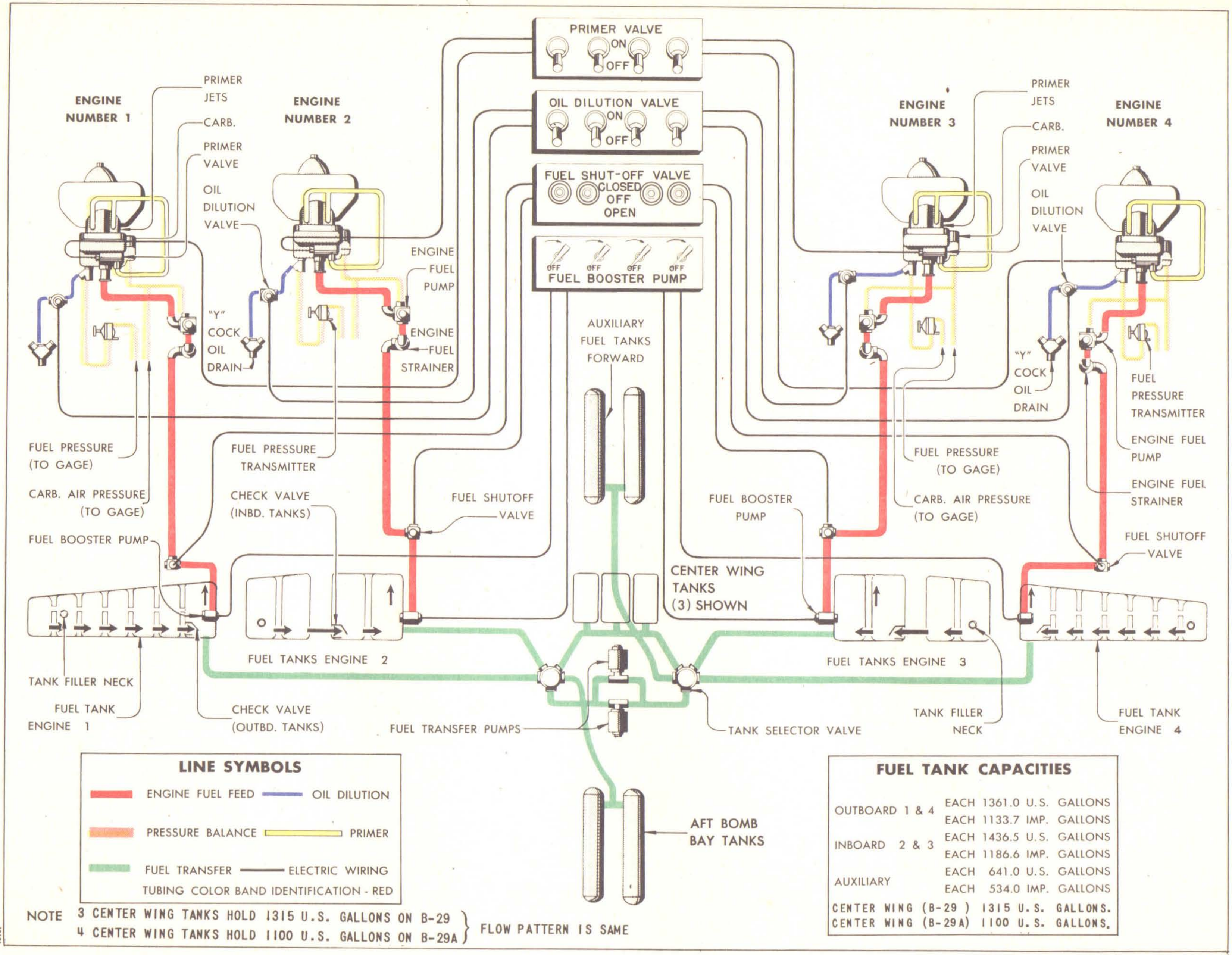


Figure 29 — Fuel System Flow Diagram (Late Airplanes)

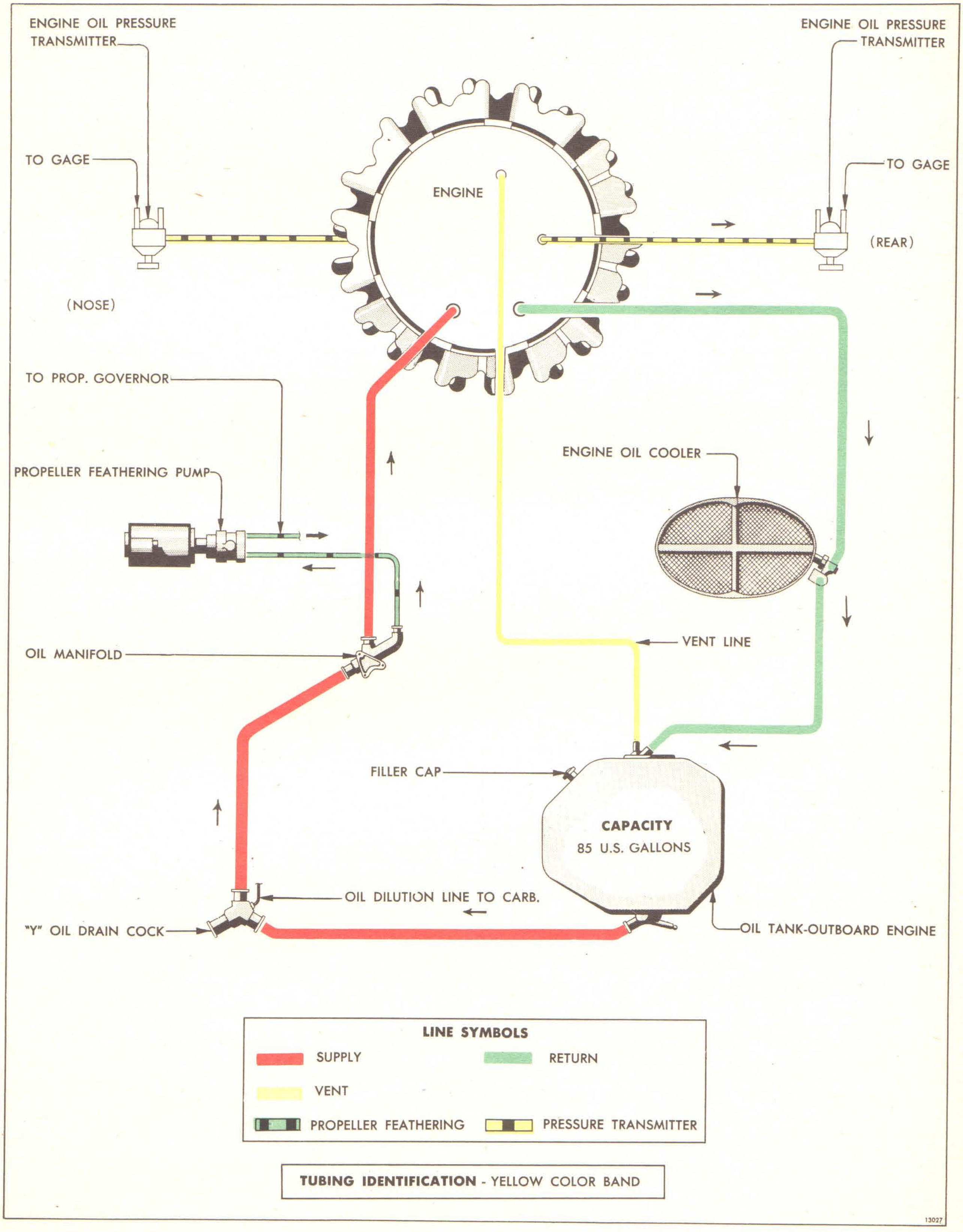


Figure 30.—Oil Flow Diagram

SECTION II

OPERATING INSTRUCTIONS

13055

1. FLIGHT RESTRICTIONS

a. MANEUVERS PROHIBITED.—The following maneuvers are prohibited: DIVE, LOOP, SPIN, ROLL, IMMELMAN TURN, VERTICAL BANK, and INVERTED FLIGHT.

b. AIRSPEED LIMITATIONS.

(1). LOWERING FLAPS.—Don't lower the flaps *completely* at speeds in excess of 180 MPH, IAS. The maximum allowable speed at which the flaps may be lowered 25 degrees is 220 MPH, IAS.

(2) LOWERING LANDING GEAR.—Don't lower the landing gear at speeds in excess of 180 MPH, IAS. The wheel well doors are the limiting factor, for they will be torn loose at greater speeds.

2. ABBREVIATED CHECK LISTS—ALL STATIONS

a. PILOT'S AND COPILOT'S ABBREVIATED CHECK LIST.

—BEFORE ENTERING AIRPLANE:

(1) Visual Inspection — Completed

(a) Condition of tires
(b) Chocks in place
(c) Oleo struts
(d) Hydraulic lines
(e) Shimmy damper
(f) Engine fire extinguishers
(g) Cannon plugs in nacelles
(h) Wheel well door cables
(i) Pitot tube covers off
(j) Cowlings and access opening fasteners tight
(k) Engines, turbos, nacelles and air scoops
(l) Control surfaces and trim tabs
(m) Windows and blisters
(n) All seams and connections for fluid leaks
(o) Form 1A, Loading List, Weight and C.G.
(p) Crew inspection

—BEFORE STARTING ENGINES:—PILOT-

	Pilot	Copilot
(1) All ignition switches	Off	
(2) Propellers pulled through	OK	
(3) Parachute	OK	OK
(4) Clothing	OK	OK
(5) Life Preserver	OK	OK
(6) Parking brakes and chocks	SET	SET
(7) Emergency Landing Gear Door Release	In Place	
(8) Emergency Bomb Bay Door Release	In Place	
(9) Emergency Cabin Pressure Release	In Place	
(10) Landing gear transfer switch	Normal	
(11) Overcontrol (some airplanes)	Engaged	
(12) Landing gear switch and fuse	Neutral—Fuse Checked	
(13) Battery switch	On	
(14) Put-Put	Started	
(15) Hydraulic Pressure: a. Main b. Emergency	OK	OK
(16) Flight Controls	Checked	
(17) Radios	Checked	Checked
(18) Altimeters	SET	SET
(19) Turrets	Stowed	
(20) Seats and Pedals	OK	OK
(21) Lights	Checked	Checked
(22) Oxygen	OK	OK
(23) Propellers	High RPM	
(24) Turbos	"O" Dial	
(25) Engineer's Report	Check list complete. Ready to start engines.	
(26) Stand clear—Fire guard	Clear left Clear right	

—BEFORE TAXIING:

(1) Vacuum	OK	
(2) Gyros	Uncaged	Uncaged
(3) Instruments	Checked	Checked
(4) Bomb Bay Doors	Closed	Closed
(5) Alarm Bell	OK	
(6) Phone Call Signal Light	OK	
(7) Combat Station Inspection	OK	
(8) Chocks	OUT left, OUT right	
(9) Parking Brakes	Off, stand by to taxi	

—BEFORE TAKE-OFF:

(1) Emergency Brakes	Checked
(2) Nose Wheel	Straight
(3) Engine Run-up	Stand by for Engine Run-up
(4) Wing Flaps	25 Degrees
(5) Trim Tabs	Set
(6) Auto Pilot	Off
(7) Windows and Hatches	Closed Closed
(8) Turbos	No. 8
(9) Propellers	High RPM
(10) Crew	Prepare for Take-off
(11) Radio Call	Completed
(12) Throttle Brake	OK, Stand by for Take-off

—BEFORE LANDING:

(1) Notify Crew	Prepare for Landing
(2) Radio Call	Completed
(3) Altimeters	Set Set
(4) Trailing Antenna	In
(5) Auto Pilot	Off
(6) Turrets	Stowed
(7) Hydraulic Pressure a. Main b. Emergency	OK OK
(8) Put-put	On the Line
(9) Propellers	2400 RPM
(10) Landing Gear	Down and Lights On
(11) Engineer's report	Check List Complete Weight___CG___
(12) Stall speed	________ MPH
(13) Wing flaps	Standing by
(14) Turbos	No. 8

—AFTER LANDING:

(1) Hydraulic Pressure	OK
(2) Turbos	"O" Dial
(3) Propellers	High RPM
(4) Wing Flaps	Up
(5) Parking Brakes	Set
(6) Bomb Bay Doors	Open
(7) Magnetos	Checked
(8) Engines	Stopped
(9) Radios	Off
(10) Controls	Locked
(11) Wheel Chocks (Left)	Chocks in Place
(Right)	Chocks in Place Brakes Off
(12) Form 1 and 1A	Accomplished
(13) Crew Inspection	

Figure 31 — Crew Inspection

b. ENGINEER'S ABBREVIATED CHECK LIST
—BEFORE STARTING ENGINES:

(1) Engineer's preflight	Completed
(2) Forms 1, 1A, and F	Completed
(3) Parachute	OK
(4) Clothing	OK
(5) Life preserver	OK
(6) Battery switch	On
(7) Put-Put	Start
(8) Emergency hydraulic pres.	OK
(9) Hydraulic fluid	Proper level
(10) Fuel boost pumps	On
(11) Fuel transfer switches	Off
(12) Inverter	On
(13) Mixture controls	Idle cutoff
(14) Throttles	Set to start
(15) Engineer's cabin air valves and relief valve	Closed
(16) Cowl flaps	Open
(17) Intercoolers	Open
(18) Oil cooler flaps	Automatic
(19) Pitot heat	Off
(20) De-icers	Off
(21) Anti-icers	Off
(22) Generators	Off
(23) Fuel quantity gage	Check against dip stick
(24) Oil quantity gage	Proper reading
(25) Emergency system valve	Closed
(26) Oxygen	OK
(27) Lights	OK
(28) Engineer's report	Ready to start engine

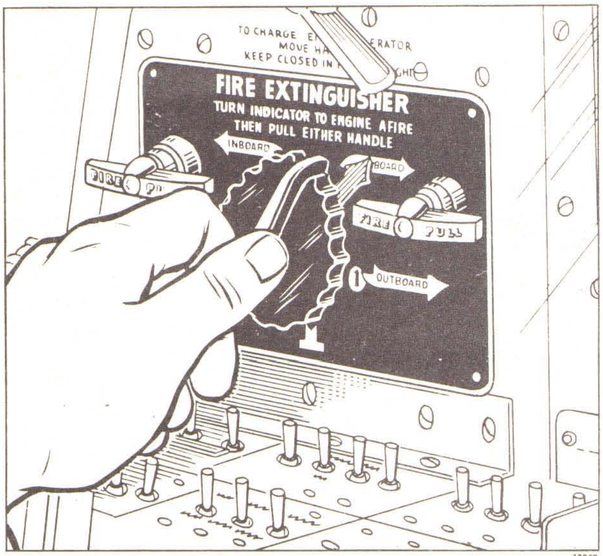


Figure 32 — Setting Engine Fire Extinguisher

—STARTING ENGINES:

(1) Engine fire extinguisher	Set to engine being started
(2) Master ignition switch	On
(3) Start engines	1, 2, 3, 4.
(4) Engine instrument readings	Checked
(5) Vacuum	Checked

—BEFORE TAXIING:

(1) Bomb bay doors	Power to close
(2) Engineer's report	OK

—BEFORE TAKE-OFF:

(1) Generators	Checked
(2) Magnetos	Checked
(3) Mixture controls	Auto-rich
(4) Fuel boost pumps	On
(5) Report	Ready for take-off
(6) Generators	On
(7) At start of take-off roll during roll, and take-off	Pull cowl flaps from 15 deg. to 7½ deg. at time wheels leave ground.
(8) Intercoolers	Open

AFTER TAKE-OFF:

(1) Wren gear is coming up	Check generators
(2) After flaps and gear are up	Have APP stopped
(3) Cowl flaps	Adjust as required
(4) Fuel boost pumps	Off

—CLIMB and CRUISE:

See Engineer's amplified check.

—BEFORE LANDING:

(1) Weights and C.G.	Call in to copilot
(2) Mixture controls	Auto-rich
(3) Put-Put	Start
(4) De-icers	Off
(5) Anti-icers	Off
(6) Fuel boost pumps	On
(7) Inter coolers	Open
(8) Cowl flaps	Open to 7½ deg.
(9) Emergency hydraulic pres.	OK
(10) Report	Ready for landing

—AFTER LANDING:

(1) Cowl flaps	Open
(2) Inter coolers	Open
(3) Generators	Off
(4) Boost pumps	Off
(5) Bomb bay doors	Power to open
(6) Magnetos	Checked
(7) Engines	Idle cut-off
(8) All switches	Off
(9) Wheel chocks	In place
(10 Brakes	Off
(11) Controls	Locked
(12) Flight log	Complete
(13) Forms 1, 1A	Complete
(14) Give crew chief report of malfunctions	
(15) Assist in location of troubles	

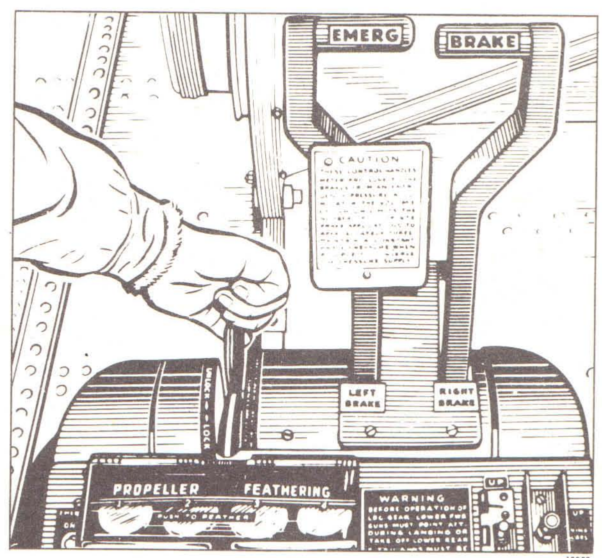


Figure 33 — Locking Flight Controls

c. BOMBARDIER'S ABBREVIATED CHECK LIST

—BEFORE STARTING ENGINES:

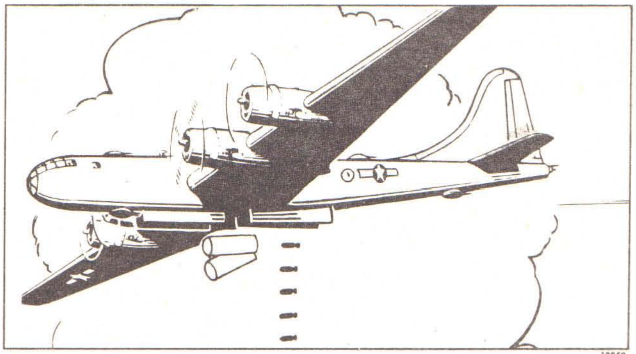
(1)	Bombsight	Pre-flighted
(2)	Autopilot	Pre-flighted
(3)	Racks	Pre-flighted
(4)	Bomb bay tank safety switches	Checked
(5)	Bombs	Inspected
(6)	Pins	Pulled
(7)	Oxygen & mask	Checked
(8)	Parachute	OK
(9)	AB Computer and scales	Checked
(10)	Fuses and spares	Checked
(11)	Interphone	Checked
(12)	Altimeter	Set
(13)	Clock	Synchronized
(14)	Intervalometer properly set	Checked
(15)	Bomb formation lights	Checked
(16)	Target information	Checked
(17)	Bombardier's kit	Complete
(18)	Nose compartment	Clear
(19)	Windows	Clean
(20)	Nose sighting station	Pre-flighted
(21)	Camera equipment	Checked
(22)	Checked with weather office	OK
(23)	Switches in Bombardier's compartment	Off

—IMMEDIATELY BEFORE INITIAL POINT:

(1)	All bombsight switches	On
(2)	Altitude computations	Complete
(3)	Disc speed and trail in sight	OK
(4)	Proper rack selector switches	On
(5)	AB Computer properly set up	OK
(6)	Bomb bay doors	Open
(7)	Bombsight stabilizer	Level
(8)	Intervalometer properly set	Checked
(9)	Autopilot being used	OK
(10)	Camera intervalometer	On
(11)	Camera Doors	Open

—BEFORE LANDING:

(1)	Bombsight switches	Off
(1)	Bombardier's panel switches	Off
(3)	Nose sighting station switches	Off
(4)	Sight	Covered
(5)	Bombing equipment malfunction report	Complete



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d. NAVIGATOR'S ABBREVIATED CHECK LIST

—PRE-FLIGHT:

(1)	Mission data	OK
(2)	Navigation kit (complete)	OK
(3)	Maps and charts	OK
(4)	Weather	OK
(5)	Time tick radio check	OK

—BEFORE STARTING ENGINES:

(1)	Personal effects (clothing, parachute, oxygen mask, life vest)	OK
(2)	Headset and microphone	OK
(3)	Oxygen system	OK
(4)	A.P.I. checked for coordinates of departure and proper color for latitude	OK
(5)	Astro-compass	OK
(6)	Synchronization of all time pieces	Completed
(7)	Check for calibration cards	OK

—WHILE TAXIING:

(1)	Check operation of Flux-Gate compass	OK
(2)	Turn on A.P.I. (Set variation on the A.P.I. Computer)	OK

—DURING FLIGHT:

(1)	Use all methods of Navigation	Completed
(2)	Altitude and Air-speed hand-set Unit (*a*) Set in the following: (Check every 10 minutes) Temperature—(within 5 deg.) Altitude—(within 500 feet) Indicated Air Speed—(within 5 mph.)	Completed
(3)	Navigator's log	Completed

—AFTER LANDING:

(1)	Switches	Off
(2)	Crew inspection	

GCT	NSS (ANNAPOLIS)	NPG (MARE ISLAND)	NPH (PEARL HARBOR)	NBA (BALBOA, C.Z.)
0000		115		
0300		115,9090 12540		
0400	113,4390 9425,12630		113,9090 12540	
0500				148,5540 11080
0800		115		
1000	113,4390 9425,12630			
1500		115,9090 12540		
1600	113,4390 9425,12630		113,9090 12540	
1700		115		148,5540 11080
2000		115	113,9090	
2200	113,4390 9425,12630			

13060

Figure 34 — Radio Time Ticks

e. RADIO OPERATOR'S ABBREVIATED CHECK LIST

—BEFORE STARTING ENGINES:

NOTE

If put-put or external power is available, radio operator should complete his operational pre-flight before crew inspection.

(1) Aerial Radio Operator's kit	Completed
(2) Antennas	Checked
(3) Fuses	Checked
(4) Plugs	Checked
(5) Tuning cables	Checked
(6) Form 1A	Checked
(7) SCR-578	Checked
(8) Facility Charts	Completed
(9) Crew Inspection	
(10) Parachute	Checked
(11) Clothing	Checked
(12) Life preserver	Checked
(13) Oxygen	Checked
(14) Battery switch	On
(15) Command Set	Checked
(16) Interphone	Checked
(17) Aldis Lamp	Checked

—BEFORE TAXIING:

(1) Liaison set	Checked
(2) Radio compass	Checked
(3) SCR-522	Checked
(4) RC-103	Checked
(5) Form 1A	Signed
(6) Interphone	Stand by
(7) Bomb bay doors	Closed
(8) Crew report	OK

—BEFORE LANDING:

(1) Station	Closed
(2) Trailing antenna	In
(3) Interphone	Stand by

—AFTER LANDING:

(1) Radio	Off
(2) Bomb bay doors (Visual check)	Open
(3) Form 1A	Completed
(4) Crew inspection	

f. TOP GUNNER'S ABBREVIATED CHECK LIST

—BEFORE STARTING ENGINES:

(1) Pre-flight inspection of sights, turrets, guns, ammunition, camera, etc.
(2) Crew inspection
(3) Interphone check
(4) Parachute and oxygen
(5) Clothing

—BEFORE TAXIING:

(1) Engine alert
(2) Alarm bell
(3) Phone call signal light
(4) Combat station inspection

—BEFORE TAKE-OFF:

(1) Taxi alert
(2) Prepare for take-off

—AFTER TAKE-OFF:

(1) When in the air: check operation of sight, turrets, and guns.
(2) Enemy aircraft alert

—BEFORE LANDING:

(1) Clear the guns
(2) Stow equipment and turn switches off when copilot gives order, "Prepare for landing."

—AFTER LANDING:

(1) Check to be sure guns are cleared
(2) Field strip guns for cleaning
(3) Malfunction report.

g. LEFT AND RIGHT GUNNER'S ABBREVIATED CHECK LIST

—BEFORE STARTING ENGINES:

(1) Pre-flight inspection: sights. turrets, guns, ammunition, camera, etc.
(2) Crew inspection
(3) Interphone check
(4) Flight controls
(5) Parachute and oxygen
(6) Clothing

—BEFORE TAXIING:

(1) Engine alert
(2) Bomb bay doors closed
(3) Phone call signal light
(4) Combat station inspection

—BEFORE TAKE-OFF:

(1) Taxi alert
(2) Wing flap report (25 deg.)
(3) Prepare for take-off

—AFTER TAKE-OFF:

(1) Landing gear and flaps (full up)
(2) In the air, operate sights and turrets, and test fire the guns.
(3) Enemy aircraft alert

—BEFORE LANDING:

(1) Equipment stowed and switches off, when copilot gives order, "Prepare for landing."
(2) Landing gear report (down and locked)
(3) Flap report

—AFTER LANDING:

(1) Bomb bay doors open
(2) Guns cleared
(3) Field strip guns for cleaning
(4) Malfunction report

h. TAIL GUNNER'S ABBREVIATED CHECK LIST

—BEFORE STARTING ENGINES:

(1) Pre-flight inspection: sight , turret , guns, ammunition, camera, etc.
(2) Crew inspection
(3) Start put-put (when battery switch is turned on)
(4) Interphone check
(5) Parachute and oxygen
(6) Clothing

—BEFORE TAXIING:

(1) Phone call signal light
(2) Combat station inspection

—BEFORE TAKE-OFF:

(1) Taxi alert
(2) Prepare for take-off

—AFTER TAKE-OFF:

(1) Put-put off (after gear and flaps are up)
(2) In the air, operate sight and turret , and test fire the guns.
(3) Enemy aircraft alert.

—BEFORE LANDING:

(1) Clear the guns
(2) Stow equipment and turn switches off, when copilot gives order, "Prepare for landing."
(3) Put-put started (as soon as above is accomplished)
(4) Notify copilot when put-put is on the line.

—AFTER LANDING:

(1) Put-put off at flight engineer's command.
(2) Check to be sure guns are cleared.
(3) Field strip guns for cleaning.
(4) Malfunction reports.

Figure 35 — Tail Gunners' Enclosure

3. PREFLIGHT CHECK

a. ENGINEER'S PREFLIGHT CHECK, AMPLIFIED.—The Flight Engineer will figure progress curves for both 3 and 4 engine operation, and figure for an alternate airport, considering both distance and weather conditions. Perfect maintenance is not an impossibility, but no flight engineer dares presume that such a condition is prevalent. Hence, it is necessary to give the airplane a thorough preflight inspection. Check the following items:

(1) Fuel tanks for servicing and proper installation of tank caps.

(2) Oil tanks for servicing and proper installation of caps.

(3) Turbo oil supply.

(4) Cowling, condition and proper fastening.

(5) Cowl flaps for proper operation.

(6) General condition of skin and control surfaces.

(7) Condition of de-icer equipment (if applicable).

(8) Life raft doors for proper installation.

(9) All navigation or running lights.

(10) Remove air scoop seals and any obstructions.

(11) Engine nose sections (cracks, cylinders for condition of cooling fins and baffles, exhaust collector rings for burning).

(12) Remove pitot covers.

(13) Wheel locks removed (early airplanes only).

(14) Turbos, check for cracks, binding wheels or oil leaks (in excess).

(15) Under surfaces wings and fuselage.

(16) Bomb bay, bomb racks and cannon plugs.

(17) Propellers and governors for nicks and oil leaks.

(18) Auxiliary oil tank and motor and selector valves in off position.

(19) Fuel transfer system.

(20) Auxiliary power plant for servicing and condition.

(21) Bus selector switch for normal position.

(22) All articles are securely fastened.

(23) Emergency flap motor for proper installation.

(24) Bomb bay fuel tanks and selector valves.

(25) All visible cables for breaks and chafing.

(26) Axe, thermos jug, and fire extinguishers.

(27) First aid kits.

(28) Anti-icer tanks and fluid.

(29) Pressure doors closed and hinges for warping.

(30) Pressure regulator caps in up position.

(31) Tool kits installed.

(32) Oxygen equipment and pressure.

(33) Hydraulic tank for servicing.

(34) Turbo amplifiers installed.

(35) Fuse panels for spare fuses.

(36) Check for the following forms:
(*a*) Form F

(*b*) Form 1 and 1A (for status of airplane)

(*c*) Load adjuster

(37) All personal equipment and Engineer's station.

b. GROSS WEIGHT AND LOADING.—The B-29 is capable of being loaded to very high weights and the effect of such weights upon the airplane performance is very large. The rate of climb, take-off distance, and other such characteristics of the airplane are excellent at light gross weights. As the weight increases, these characteristics gradually change and at the highest weights, some of the airplane's performance characteristics become poor. The weight to which the airplane may be loaded depends primarily upon the ability of the crew to get the best from the airplane. The maximum weight of the airplane is therefore limited only by performance and it is of the utmost importance that it be properly controlled. Even though the weight of the airplane is below maximum, all equipment not necessary for the proposed mission and which is readily removable from the airplane should be removed prior to starting on the particular mission. Every pilot knows that for each pound of surplus or unnecessary equipment removed, one more pound of fuel or bombs can be added; or that the performance will be improved at lighter gross weights. Incidentally, the maximum altitude for any mission can be increased one foot for every two pounds removed from the airplane. Also for each 6 pounds added to the empty weight of the airplane, it is necessary to add one gallon of gasoline to get the same range. Thus the gross weight is increased twelve pounds.

Complete weight data, and chart showing the location of the center of gravity of the airplane under various conditions, are provided with each airplane.

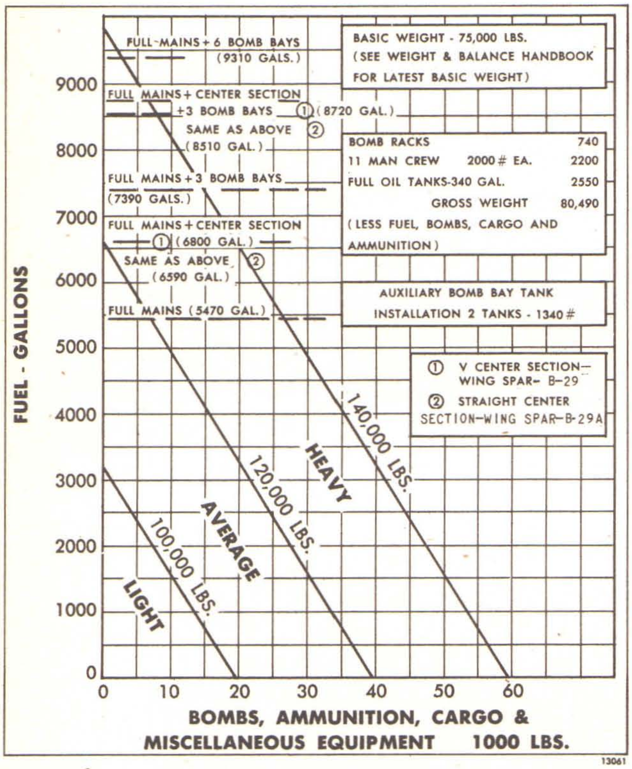


Figure 36 **— SAMPLE LOADING CHART**

c. PILOT'S VISUAL CHECK, AMPLIFIED.—A visual inspection by the pilot will include the following:

(1) Condition of tires—examine carefully for cuts and slippage.

(2) Wheel chocks—2" in front of inboard tires and 2" behind outboard tires.

(3) Oleo struts—13¼" between pin centers on main gear, 10" on nose gear.

(4) Hydraulic lines—check for leaks.

(5) Shimmy damper—check oil level. Top of pin should be even with groove.

(6) Engine fire extinguishers—check red disk at end of line running down from each CO_2 bottle (nose wheel well). Also check safety wire on handle at top of bottle. This wire must be intact—fine, brass, safety wire. If heavy wire is used, the flight engineer won't be able to pull extinguisher control handle (flight engineer's panel). If the control handle has been pulled, safety wire will be broken. If bottle has been discharged, red disk will be missing.

(7) Gear motor and door motor cannon plugs—check each plug for looseness. If the rotating collar is not scrwed tight, engine vibration can shake loose the cannon plug connection.

(8) Cables on main wheel well doors—cables should be on pulleys and free of obstructions.

(9) Pitot tube covers off.

(10) All fastenings on inspection plates and engine cowling should be tight.

(11) See that engines and nacelles are free of oil and grease. Oil or grease is a fire hazard. Have it cleaned off before making the flight. Check turbosuperchargers. Inspect air scoops for obstructions.

(12) Inspect control surfaces and trim tabs for dents or damage.

(13) Inspect all windows and blisters for cracks and dirt.

(14) Check all seams and connections for fluid leaks.

(15) Form 1A, Loading List, Weight and C.G. Checked. Flight engineer will hand the pilot, for approval and signature, the Form 1A, loading list, and weight and balance sheet (Form F). Pilot will sign the Form 1A Exceptional Release, if necessary, and see that C.G. is between limits (minimum between 18% and 24%, maximum at 34%).

(16) Crew Inspection Completed.

Pilot will have the crew line up to the left of the airplane's nose in the following order: copilot, bombardier, navigator, flight engineer, radio operator, gunners, and passengers. Crew will then be inspected for physical condition and equipment, including oxygen masks, parachutes, flying clothing, and identification tags. Pilot will see that each crew member is familiar with his duties and with emergency procedures.

d. HOW TO GAIN ENTRANCE.—Entrance is made to the forward compartment through the nose wheel well and floor hatch. The rear main entrance door is on the right side, aft portion of the airplane. See figure 5, page 2.

4. BEFORE STARTING ENGINES.

a. PILOT'S AMPLIFIED CHECK.

(1) IGNITION SWITCHES—See that all ignition switches are turned off.

(2) PULL PROPELLERS THROUGH.—If the engines have been off more than 30 minutes, signal the other crew members or ground crew to pull the propellers through at least 16 blades. Pull first four blades with care to detect obstructions. If obstruction is encountered remove front plugs from lower cylinders and pull propellers through several revolutions. *Any attempt to clear engine cylinders of liquid lock by other means is prohibited. Do not jerk the propeller or pull it backwards.*

(3) PARACHUTE O.K.—Pilot and copilot put on parachutes at this time, and check for location of their seat-type dinghies if the airplane is fitted with them.

(4) CLOTHING O.K.—Pilot and copilot check on their clothing and the operation of their electric suits. Also adjust helmet, throat microphone, and attach oxygen mask to the left side of helmet.

(5) LIFE PRESERVER O.K. — On all overwater flights, pilot and copilot check to see if their life vests are fitted with CO_2 cartridges. Wear parachute harness over life vest, except for parachute chest strap, which should be under vest.

(6) PARKING BRAKES AND CHOCKS SET. — Pilot depresses rudder pedals and pulls out the parking brake lever. He and the copilot look out the windows on their respective sides to see that chocks are in place as explained in Pilot's Visual Inspection.

(7) EMERGENCY NACELLE DOOR AND CLUTCH HANDLE IN PLACE.—Pilot checks release handle in its proper place. Pulling this handle releases nacelle doors on early airplanes. The emergency release handle is removed from airplanes with manual emergency landing gear system.

(8) EMERGENCY BOMB BAY DOOR RELEASE IN PLACE.—T-Handle on pilot's control stand.

(9) EMERGENCY CABIN PRESSURE RELEASE IN PLACE.—T-Handle on pilot's control stand.

(10) LANDING GEAR TRANSFER SWITCH "NORMAL."—On early airplanes, the pilot checks the landing gear transfer switch in "NORMAL" position. In this position the main landing gear and nose gear are operated by the Landing Gear switch. Late airplanes with the manual emergency landing gear system do not have a landing gear emergency transfer switch.

(11) THROTTLE OVERCONTROL ENGAGED. —Pilot sees that the throttle overcontrol lever, on the pilot's control stand (early airplanes only) is in the "ENGAGED" position (full forward). This engages the engineer's throttle.

(12) LANDING GEAR SWITCH NEUTRAL AND FUSE CHECKED.—Switch (pilot's aisle stand) should be neutral. Check to see that fuse in pilot's aisle stand is in place and not burned out.

(13) BATTERY SWITCH ON.—Flight engineer flips battery swtich "ON" and notifies pilot. All electrical circuits can be energized either by the battery or the auxiliary power unit, or both. Both are used for normal ground operation on loads up to 200 amperes. For additional power, use an external power source or engine-driven generators.

(14) PUT-PUT STARTED. — Copilot tells tail-gunner to start the put-put.

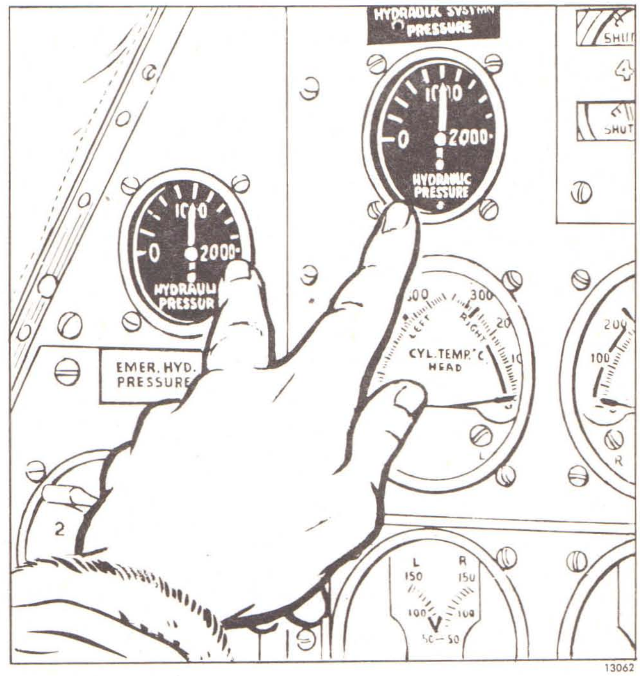


Figure 37 — Engineer's Hydraulic Gages

(15) HYDRAULIC PRESSURE O.K.—The copilot asks the flight engineer to check the emergency hydraulic pressure on engineer's panel (900-1075 lbs.) and checks the hydraulic pressure gage on his own instrument panel for a pressure of between 800 and 1000 PSI. A fluctuating needle indicates a faulty pressure regulator. If the hydraulic pump should overheat and smoke, remove the fuse on the engineer's aft fuse panel. To prevent overheating, see that the pump stops when the pressure reaches 1000 PSI.

WARNING

If an expander tube is broken while taxiing, use Emergency brakes only. Use of both normal brake pedals at the same time would provide no braking on either side and would allow all fluid and pressure in the normal system to drain through the broken tube. Use of both emergency brakes at the same time will provide 100% braking on the good side (left gear, for example) and 50% braking on the bad side (right gear, for example). And by switching the hydraulic servicing valve (engineer's panel) to emergency, pressure and fluid can be maintained indefinitely in both the normal and emergency systems. In those cases where all fluid and pressure in the normal system is lost, check valves prevent loss of fluid in the emergency lines, regardless of position of hydraulic servicing valve, and these lines hold enough fluid for from five to seven applications of the emergency brakes.

(16) FLIGHT CONTROLS CHECKED. — Pilot pushes down locking lever located at forward end of pilot's aisle stand. This also unlocks the throttles which are held in the closed position by lock bar when the control lock is on. This lock bar is linked to the control lock in such a way that strong forward pressure on the throttles will force the control lock off and eliminate the possibility of locked controls on take-off. The control check is made by the copilot. In making the check, the copilot announces over the interphone, "Copilot to gunners, stand by to check controls." He then pulls the control column back and says on interphone, "Check elevators." Left gunner answers, "Left elevator up, sir." Right gunner answers "Right elevator up, sir." The copilot then pushes the column forward and completes his check on the elevators. Ailerons and rudder are checked in the same manner.

(17) RADIOS CHECKED. — While copilot is checking flight controls, pilot turns "ON" his command set, requests and receives taxi information. Copilot, after checking controls, turns "ON" radio compass, and checks for proper operation. He then turns radio compass "OFF" and stands by on interphone so that he can be in continuous contact with the crew.

(18) ALTIMETERS SET.—Pilot and copilot set their altimeters by the tower altimeter setting. Check the altitude reading against the known field elevation. If the altimeter setting given by the tower indicates an altitude different from the known field elevation, check the setting again and note any difference in elevation so it can be used in correcting the reading when landing.

(19) TURRETS STOWED. — Pilot checks the three turret warning lights on his instrument panel to see that all turrets are properly stowed. Turret lights should be "OFF."

(20) ADJUST SEAT AND PEDALS.

(21) LIGHTS CHECKED.—If any night operation is contemplated on the flight, all lights must be checked—fluorescent lights, identification lights, landing lights, position lights (all switches on pilot's aisle stand). A member of the ground crew should be instructed to check the landing lights and position lights. Wing position lights are not visible from inside the airplane in flight. They can be inspected at night from inside the airplane only by checking their reflection on the ground under the wing tips.

(22) OXYGEN O.K. — Pilot and copilot check their oxygen pressure gages for proper pressure (400 to 425 PSI) and their walk-around bottles (should have same pressure as in system). Auto mix should be ON, and the emergency valve "OFF."

(23) PROPELLERS HIGH RPM.—Copilot pushes the propeller switches (aisle stand) to "INCREASE RPM" and holds them there until the propeller limit lights on his instrument panel flash on. The propellers then will be in high RPM.

(24) TURBOS OFF.—Pilot checks to see that the turbo selector dial is set at "0." Turbosupercharger regulators are ready for instant operation at any time since amplifier tubes remain on even with selector dial at "0."

(25) ENGINEER'S REPORT.—Check list complete, ready to start engines. At this point, if the engineer has not completed his check list, the pilot waits before giving the command to start engines.

(26) STAND CLEAR—FIRE GUARD. — Clear left, clear right. When ready to start the engines both the pilot and copilot give the command "Stand Clear" to the ground crew (clear right, clear left). When the fire guard is ready, copilot says on interphone, "Stand by to start engines."

b. SPECIAL CHECK FOR NIGHT FLIGHTS:

(1) Panel lights.

(2) Fluorescent lights.

(3) Landing and passing lights.

(4) Navigation formation and recognition lights.

(5) Spare lamps.

(6) Spare fuses.

(7) Flares.

(8) Signal lamps.

(9) Blackout curtains.

c. ENGINEER'S AMPLIFIED CHECK LIST

(1) PREFLIGHT CHECK.—Completed.

(2) FORMS 1, 1A, AND F.

(a) Check Form 1 and 1A and advise pilot of status of airplane. After entering the airplane, the flight engineer should go through the following check list very thoroughly.

(b) Fill out loading list and Form F. (Give to ground crew to turn in to Operations.)

Figure 38 — Checking Heated Suit

(3) PARACHUTE.—Check for condition.

(4) CLOTHING.—Check for proper clothing for mission to be performed.

(5) LIFE PRESERVER.—For over-water mission, check CO_2 bottles for safety, and vests for condition.

(6) BATTERY SWITCH. — At copilot's command, turn switch "ON."

(7) AUXILIARY POWER PLANT.—Have put-put started, warmed up, and "on the line."

(8) EMERGENCY HYDRAULIC PRESSURE.—Check for 900-1,075 PSI.

(9) HYDRAULIC FLUID.—With parking brakes set, and pressure at 1000 PSI, check for 2 gallon capacity.

(10) FUEL BOOST PUMPS. — Early airplanes: Turn pump switches "ON"; turn rheostats to get 14-16 PSI with mixture control cracked; return mixture to idle cut-off; turn pump switches "OFF."

(a) Later airplanes: Pump switch is incorporated in the rheostat control knob.

(11) FUEL TRANSFER SWITCHES.—Check for "OFF" position.

(12) INVERTERS.—Check normal and alternate inverter for 26 - 26½ volts, leaving normal inverter "ON."

(13) MIXTURE CONTROLS.—Idle cut-off.

(14) THROTTLES.—Open 1 - 1½ inches, to obtain 900—1200 RPM for starting.

(15) ENGINEER'S CABIN AIR VALVES AND PRESSURE RELIEF VALVE. — Keep closed for all ground operations.

(16) COWL FLAPS.—Flaps will be full open for all ground operations.

(17) INTERCOOLERS. — Full open for ground operation.

(18) OIL COOLER FLAP.—Check operation by putting doors to full open position, obtain position report from gunners. Close and put in automatic.

(19) PITOT HEAT. — Leave in "OFF" position for ground operation.

(20) DEICERS.—Check for operation and leave in "off" position for take-off and landing.

(21) ANTI-ICERS.—Check for operation and return to "off" position.

(22) GENERATORS.—Switches "OFF."

(23) FUEL GAGES. — Record and check against dip stick.

(24) OIL GAGES.—Record and check against dip stick.

(25) HYDRAULIC SERVICING VALVE. — "CLOSED."

(26) OXYGEN.—Check for proper pressure and operation of A-12 regulator and blinker.

(27) LIGHTS. — Check for operation and spare bulbs.

(28) ENGINEER'S REPORT.—When check list is completed, inform pilot you are ready to start engines.

Figure 39 — Signal to Start Engine

5. STARTING ENGINES

a. STARTING PRECAUTIONS.

(1) Don't start the engines until the "Before Starting Check" has been covered item by item. (See Section II, Paragraph 4).

(2) Don't start the engines until the propellers have been pulled through to eliminate any possibility of fluid locks.

(3) Don't start engines until a fire guard is posted.

(4) Don't jam throttle forward at any time.

(5) Don't continue to run an engine unless nose and rear oil pressure build up to normal within 30 seconds after starting.

b. ENGINEER'S AMPLIFIED CHECK.

(1) FIRE EXTINGUISHERS.—Set selector to engine being started.

(2) MASTER IGNITION SWITCH—"ON".

(3) START ENGINES 1, 2, 3, 4.

(a) Turn fuel boost pump "ON".

(b) Energize starter 12 to 16 seconds.

(c) Engage starter.

(d) When propeller has turned one revolution, turn ignition switch "ON".

(e) Prime as needed to start, and smooth out engine at 800 to 1000 RPM.

(f) Move mixture control to "AUTO RICH" and keep it in "AUTO RICH" for all ground running.

(4) ENGINE INSTRUMENTS.—Check oil pressure (nose and rear) manifold pressure, RPM, and oil temperature.

(5) VACUUM.—Check for (3.8-4.2 Hg.).

c. AFTER STARTING.—When engine 1 is started and checked, the flight engineer reports "Engine operating normally" and will announce "Ready to start number 2 engine". The procedure continues thus for engine number 3 and number 4. Engineer will handle throttles throughout entire starting procedure, keeping RPM between 1000 and 1200 for warm up. When engine is running properly he will set his throttle at 700 RPM, (1000 RPM if cylinder head temperature is below 150°C). Thereafter the pilot will control throttles except when calling for engine driven generators, and during engine runup. If copilot or engineer see that an engine is loading up (black smoke, or RPM drop, or both) he will inform the pilot.

6. BEFORE TAXIING.

a. PILOT'S AMPLIFIED CHECK LIST.

(1) VACUUM OK.—The copilot asks the flight engineer to check vacuum reading. The flight engineer, after checking the vacuum reading for both pumps (gage on engineer's panel should read 3.8" to 4.2" Hg.), reports this check to the copilot.

(2) GYROS UNCAGED.—Pilot and copilot check their gyro instruments to make sure that they are uncaged and set correctly.

(3) INSTRUMENTS CHECKED.—Pilot and copilot check their respective instrument panels for proper readings on all instruments.

(4) BOMB BAY DOORS CLOSED.—After the copilot has instructed the gunners and radio operator to check and see that all members of the ground crew are clear of the bomb bay doors, he says to the flight engineer, "Generators on coolest engine", and tells the bombardier to close the bomb bay doors. Flight engineer has meantime set throttle on coolest engine to 1400 RPM and turned generators on. The radio operator and one of the gunners check through the pressure doors and report to the copilot that the bomb bay doors are closed. Flight engineer returns throttle to 700 RPM when copilot says, "Generators off".

(5) (6) and (7) ALARM BELL, PHONE CALL SIGNAL, LIGHT, AND COMBAT STATION INSPECTION.—Pilot switches on alarm bell (aisle stand) and phone call signal light (aisle stand), then calls for combat station inspection. Copilot repeats this command on interphone and receives acknowledgment in the following manner: bombardier, navigator, flight engineer, radio operator (in that order) acknowledge that they have completed a check of their stations by saying, for example, "Bombardier OK". Top gunner says "Alarm bell OK, light OK, top gunner OK". Tail gunner says, "Light OK (radar compartment), tail gunner OK".

(8) CHOCKS OUT.—Pilot and copilot check to see that chocks have been pulled.

(9) PARKING BRAKES OFF, STAND BY TO TAXI.—After releasing the parking brakes, the pilot gives the command to "Stand by to taxi." The copilot repeats the command over the telephone.

b. ENGINEER'S AMPLIFIED CHECK LIST.

(1) POWER TO CLOSE BOMB BAY DOORS.—When copilot says "Generators on coolest engine", flight engineer advances throttle on coolest engine to 1400 RPM and turns generators on. Turn generators off and retard throttle when doors are closed.

(2) ENGINEER'S REPORT. — At copilot's request, during combat station inspection, say, "Engineer OK".

c. NORMAL INSTRUMENT READINGS.

Nose Oil Pressure	30-50 PSI
Rear Oil Pressure	60-80 PSI
Fuel Pressure	15-18 PSI
Oil Temperature	55-95°C. (131-203°F.)
De-icer Pressure	7-7.5 PSI
Vacuum Pressure	3.8″-4.2″ Hg.
Oxygen Pressure	400-425 PSI
Hydraulic Pressure (Normal)	800-1,000 PSI
Hydraulic Pressure (Emergency)	900-1,075 PSI

7. TAXIING INSTRUCTIONS.

a. GENERAL.—Like all tricycle-landing-gear airplanes, the B-29 taxis easily. Brakes are good—4 expander tubes per wheel. However, REMEMBER, it is a big, heavy airplane. It gains momentum rapidly and, because of its size, you will have to depend on your side and top gunners to act as observers to warn you of obstacles.

b. PRECAUTIONS

(1) MIXTURE.—For all ground operations, set RPM at 700 (after cylinder head temperatures reach 150 C. (302 F) and mixture "AUTO RICH." Never use auto-lean for taxiing. If carburetors are set properly, engines will idle as low as 550 RPM without loading up.

(2) USE OF BRAKES.—Brakes alone should be used for control of speed and direction to prevent backfires and to get maximum cooling. To enter a taxi turn with outside throttle doesn't save brakes because the extra power causes quick acceleration and requires braking to slow down. If you gain too much speed, bring the airplane almost to a stop, straight ahead, then stay off the brakes as long as possible to let them cool. Don't ride your brakes. Don't pivot on one wheel.

(3) TAXIING IN CROSSWIND.—Like most airplanes, the B-29 "weathervanes" into the wind. For this reason, when taxiing in a strong crosswind, set upwind, outboard throttle at more than 700 RPM to prevent excessive use of downwind brake.

8. BEFORE TAKE-OFF

a. PILOT'S AMPLIFIED CHECK LIST.

(1) EMERGENCY BRAKES CHECKED.—After parking brakes are released, when starting to taxi, copilot says, "Emergency Brakes." Pilot then pulls the emergency brakes hand metering levers (pilot's aisle stand) to see that emergency brakes are operating properly on both sides. Copilot then tells flight engineer to recharge emergency system. Normal brakes may be safely used while recharging the emergency system, since the electric hydraulic pump recharges both systems with the hydraulic servicing valve on emergency.

(2) NOSE WHEEL STRAIGHT.—Copilot checks through cockpit floor observation window to make sure the nose wheel is straight before engine run-up.

(3) ENGINE RUN-UP.—The pilot gives the command "Stand by for engine run-up" and the copilot repeats the command over the interphone. The engine run-up for first take-off should be accomplished in the following manner: (For subsequent take-offs, eliminate entire procedure, items *(a)* through *(f)*

(a) Pilot increases all throttles to 1500 RPM and tells flight engineer to check generators.

(b) To test propeller governors, the pilot will operate all four propeller selector switches to "FULL DECREASE" (limit light), check tachometers for stable, uniform reading of 1200-1300 RPM. Return to "FULL INCREASE" (limit light), where the tachometers should read 1500 RPM as before. Any propeller overshooting the original setting is not being properly governed, and this malfunction must be corrected before take-off is attempted.

(c) When props and generators are checked, pilot pulls all throttles back to 700 RPM and tells flight engineer to "Check magnetos."

(d) Flight engineer advances No. 1 throttle to 2000 RPM, checks magnetos and calls out, "Right, Both, Left, Both." Flight engineer then returns throttle to 700 RPM. At this time, check each engine for manifold pressure necessary to get 2000 RPM. At sea level, approximately 30 inches HG. is normal. Above sea level, subtract one inch for each thousand feet of altitude. Changes in temperature will vary these settings, but the variation will be the same for all engines. Excessive manifold pressure on one engine is an indication of a bad cylinder, a bad valve, or some other engine malfunction.

(e) Magneto check is made for each engine. Allowable drop at 2000 RPM is 100 RPM. If drop on any engine is more than 100 RPM, caused by fouled plugs, return the airplane to the line.

(f) When magnetos are checked, pilot sets turbos on No. 8 and advances each throttle one at a time, full open, to check manifold pressure and RPM. For this ground check, tachometers should read between 2700 and

2800 RPM and manifold pressure should be between 48 and 49 inches Hg. After the check, pilot sets all throttles at 700 RPM, leaving turbo selector dial on "8."

WARNING

Do not hold full power on ground for more than 2 seconds. Do not check magnetos with turbos on. A backfire at this time (with turbos on) can damage turbo and waste gate assembly. Do not park airplane at 45 deg. to runway for engine run-up. Head airplane directly into the wind for maximum cooling.

(4) WING FLAPS 25 DEG.—Copilot holds wing flap switch (Pilot's aisle stand) in the DOWN position until the indicator on the copilot's instrument panel reads 25 deg. Gunners check the lowering of the flaps by reporting "Left flap down 25 deg., sir," "Right flap 25 deg., sir."

(5) TRIM TABS SET.—The pilot checks all trimtab controls—rudder and ailerons neutral, elevator as needed according to the calculated position of the center of gravity.

(6) AUTO PILOT OFF.—The pilot makes sure all switches (pilot's aisle stand) are off, with turn control centered.

(7) WINDOWS AND HATCHES CLOSED.—As the pilot closes and secures his window, the copilot closes his, checks to see that the forward compartment entrance hatch is closed, and checks over the interphone with the tail gunner to make sure that the rear entrance door and rear escape hatch are closed.

(8) Turbos on No. 8

(9) Propellers high RPM.

(10) CREW READY.—The copilot says on interphone, "Prepare for take-off."

(11) RADIO CALL COMPLETED.—Pilot calls tower and requests permission to take off.

(12) THROTTLE BRAKE ON—STAND BY FOR TAKE-OFF.—Pilot adjusts his throttle brake for desired friction to prevent slipping.

b. ENGINEER'S CHECK LIST

(1) GENERATORS.—While pilot is setting throttles at 1500 RPM, have gun amplydine generator turned "ON". While pilot is checking propellers, turn on generators one at a time. Check for voltage and amperage readings.

(2) MAGNETOS.—Advance each throttle to 2000 RPM, check magnetos for RPM drop calling out to pilot (right, both, left, both), 100 RPM maximum drop. Watch for any engine roughness.

WARNING

Open throttles slowly to prevent fire and backfiring.

(3) MIXTURE CONTROLS.—"AUTO-RICH."

NOTE

Mixture controls will be in "AUTO-RICH" for ground operation, take-off, climb, landing and cruise above 2100 RPM and 31" MP.

(4) FUEL BOOST PUMPS "ON".—Adjust to obtain 17 PSI plus or minus 2 PSI at take-off.

(5) REPORT.—When ready to take-off engineer will report to pilot, "Ready for take-off, standing by on generators and cowl flaps."

NOTE

If cylinder head temperature exceeds 220°C (428°F) before take-off, idle at 700 RPM to cool, with airplane headed into the wind.

(6) GENERATORS.—When throttles are advanced to 1200-1500 RPM, turn generators "ON".

(7) COWL FLAPS.—At start of take-off, set 15°, then milk cowl flaps slowly closed to obtain 7½ deg. at time wheels leave ground.

(8) INTERCOOLERS.—Intercoolers will be "OPEN" on take-off and landing. With turbos off, intercoolers will be "CLOSED". At altitude or when turbos are partly on, adjust to lowest carburetor air temperature. If icing is prevalent obtain 25-38 deg. carburetor air temperature.

9. TAKE-OFF

a. PROCEDURE—PILOT'S AMPLIFIED CHECK.—Cylinder head temperatures should be kept to a minimum before take-off. Never start to take-off with any cylinder head temperature above 220°C. (428 °F). If engine cannot be cooled below this limit, with RPM at 700 and airplane headed into the wind, taxi up and down the taxi strip if conditions permit. If engine cannot be cooled in this manner, return the airplane to the line.

(1) Pilot uses throttles (not brakes) to line up with runway, then, as airplane starts to roll, throttles should be "walked" forward slowly until pilot has rudder control at 60 to 65 MPH. Pilot can then move throttles steadily forward to full "OPEN" position. In this way, he can maintain directional control first with throttles, then with rudder. Brakes should not be used to hold the airplane straight on the runway, except in emergencies, since this increases the take-off distance and wears out the brakes. If throttles are advance to 40 inches Hg. at a standstill for power check, or if throttles are moved forward too quickly at the beginning of the roll, the pilot will find that he hasn't the reserve power necessary to hold the airplane straight with throttles, so until the airplane picks up speed, he is forced to

use brakes to stay on the runway. This lengthens the time required to get rudder control, and, as noted above, lengthens the take-off roll and heats up the brakes. For this reason, it is recommended that the copilot during take-off make a continuous power check as the throttles are advanced, watching all instruments closely during the take-off roll and after take-off. Never attempt take-off with less than full take-off power, 47½ inches Hg and 2600 RPM. Taking off with less power increases time necessary to reach 195 MPH, prolong hazardous flight period, and does not properly cool the engines.

(2) At 90 MPH, relieve pressure on the nose wheel by easing the control column back. The airplane will then fly itself off the ground at 115 to 130 MPH, depending on the gross weight. As soon as the ship is safely off, the pilot brakes wheels and calls for gears up.

(3) At 150 MPH, pilot calls for power condition to get 43½ inches HG. at 2400 RPM.

(4) At 160 MPH, pilot calls for flaps up easy. Flaps may be raised 5 degrees at a time if copilot waits for the airplane to fly out of the tendency to settle, before raising the flaps another 5 degrees. Gear and flaps pull a total of 965 amperes and may be safely raised together, provided 4 generators (Put-put included) are operating and provided switches are not tripped simultaneously.

(3) When gear and flaps are full up, pilot calls for power condition "3" (39" and 2300). Manifold pressure is reduced with turbo selector dial until turbos are off, at which time copilot announces to flight engineer, "Turbos off". Subsequent manifold pressure reductions are made with throttles.

(6) Cowl flaps, which are 15 degrees open as the ship takes the runway, are closed to 7½ degrees by the time the airplane leaves the ground. This setting permits rapid acceleration of air speed and should keep all cylinder head temperatures below 260 degrees.

Conversion Table on Cowl Flap Openings:
(Long chord flaps)

15 degrees equals	4½ inches
12½ degrees equals	3¾ inches
10 degrees equals	3 inches
7¼ degrees equals	2¼ inches
5 degrees equals	1½ inches
2½ degrees equals	¾ inch
0 degrees equals	0 inches

(7) If cylinder head temperatures rise above 260° C (500°F) on take-off, or stay above 248°C (475°F) after the second power reduction, flight engineer should inform the pilot. The pilot can then order cowl flaps on the hot engine opened to a maximum of 10 degrees. Never open cowl flaps more than 10 degrees in flight. Larger openings provide very little cooling, and decrease cruising ranges considerably. The pilot can throttle back on the hot engine to about 25 inches Hg. The throttle should not be pulled back unless the airplane has reached 170 MPH, IAS. Cowl flaps should be set at the smallest opening which will keep cylinder head temperatures below the required maximum. (260°C or 500°F for take-off; 248°C or 475°F for climb—continuous; 232°C or 450°F for cruising—continuous. See Section I, Paragraph 2a.)

(8) Don't try to climb too fast after take-off. Hold the airplane nearly level until reaching climbing airspeed of 195 MPH.

b. TAKE-OFF TECHNIQUE.—The B-29 take-off distance is about the same as that of the B-17 and B-24. The speed at which the airplane is pulled off is very important. A high take-off speed means a long take-off distance because the time to raise the speed above the normal take-off speed is longer and the rate at which the airplane covers the ground is greater. Extending the flaps to 25 degrees will raise the drag during the run but the flaps will also increase the wing lift and therefore take load off the wheels which in turn decreases the wheel rolling-drag. The resulting net drag is not changed much, but the take-off speed is considerably reduced. More than 25-degree flaps result in take-off losses. Ground Run vs. Airspeed Chart shows

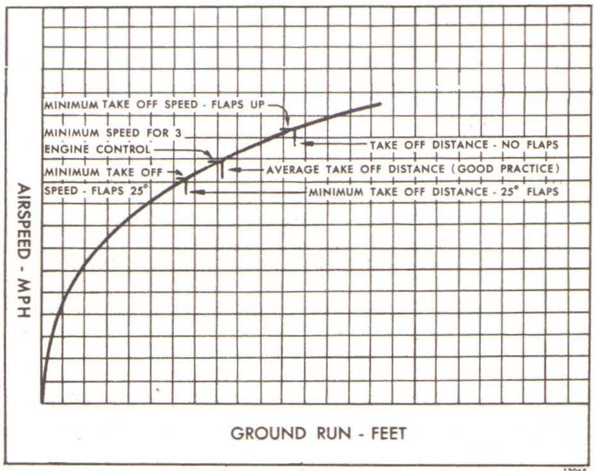


Figure 40 — Ground Run vs. Airspeed

how the distance goes up with the speed and how the flaps affect the run. It can readily be seen that the best procedure for a short take-off is to get off at a low speed. Some longitudinal instability will be noticed during runs below 90 MPH, IAS, before the elevators become very effective.

(1) Once off the ground, the shortest distance to clear near-by obstacles may be obtained by not allowing the speed to increase too much. Tests have shown that the speed can be held down to 10 MPH, IAS above the take-off speed without getting into any control difficulties. The speed in the climb-out must, of course, never be allowed to drop below the take-off speed.

(2) Retract the landing gear as soon as possible. The B-29 is aerodynamically clean; therefore the landing gear drag is relatively much greater than on most airplanes. Retracting the gear is equivalent to adding more power. At high gross weights especially, power should not be reduced until the gear is retracted.

(3) Flaps should be retracted when the speed is 40 MPH, IAS higher than take-off speed. The power-off stalling speed with the flaps up is 15 to 20 MPH, IAS higher than the lowest take-off speed with 25-degree flaps at any weight, so a margin of 20 to 25 MPH, IAS above flaps-up stalling speed must be held when retracting the flaps. The maximum allowable speed with 25-degree flaps is 220 MPH, IAS.

(4) Take-off instructions for the B-29 are included in the cockpit operational charts in all airplanes. These instructions are based on actual flight operation and they will probably be modified in the future when more is learned about the airplane. They are also given here:

(a) On runup set 2800 RPM and 49 inches manifold pressure.

(b) Set wing flaps to 25 degrees and cowl flaps to 15 degrees, close to 7½ deg. during take off.

(c) Set elevator trim tab neutral.

(d) At 2800 RPM and 49 inches Hg. accelerate to 90 MPH, IAS with nose wheel on the ground.

(e) Lower tail gradually and continue acceleration to take-off speed.

(f) Climb over obstructions at 140 MPH, IAS.

(g) Retract landing gear as soon as convenient.

(h) Retract flaps when convenient above 500 ft. and 160 MPH, IAS.

(i) At high weights do not reduce power below 2600 RPM and 47.5 inches until gear is retracted.

(j) Minimum speed for two engine control is 130 MPH.

(5) These instructions are for the usual take-off and in order to make them good for a short take-off the sixth step should be read, "Climb over obstructions at 10 MPH, IAS above take-off speed."

(6) The tail skid on the B-29 airplane helps to prevent taking off at too low an airspeed. The minimum possible take-off speed is just about the power-off stalling speed and well above the power-on stalling speed. The tail skid is designed to be used, and minimum distance take-offs will be obtained by holding the tail skid to the ground as take-off speed is reached. After leaving the ground in this manner it is extremely important to keep the airspeed above take-off speed.

10. CLIMB

The B-29 rate of climb at rated power is nearly the same as for the B-17 and the B-24 when the B-29 weighs twice as much as they do. This is reasonable since the B-29 has twice their power. The time required to climb to any altitude will be roughly the same but the B-29 will cover a greater distance in that climb.

a. PILOT'S AMPLIFIED CHECK.

(1) WEIGHT AND SPEED.—For gross weights under 115,000 lbs., climb at 39 inches Hg., 2300 RPM. For heavier weights climb at rated power (43½ inches Hg., 2400 RPM). Climbing airspeed should be 195 MPH, IAS for gross weights under 115,000. At higher gross weights, when using rated power, climb at 195-205 MPH, IAS.

(2) HIGH CYLINDER HEAD TEMPERATURES—During sustained climb, if all cylinder head temperatures are running high, hold climbing power setting and level off until cylinder head temperatures return to normal, then start climbing again.

(3) INTERCOOLER FLAPS—For take-off, intercooler flaps are full open. For climb and cruise, open intercooler flaps enough to get lowest carburetor air temperatures. However, if conditions are likely to produce ice, adjust intercooler flaps to hold carburetor air temperatures of 25-38°C (77-100°F). With turbos off, intercooler flaps should be completely closed.

b. ENGINEER'S AMPLIFIED CHECK.

(1) GENERATORS—Check for amperage draw while gear and flaps are coming up.

(2) COWL FLAPS—Adjust to maintain cylinder temperature, approximately 7½° for climb—maximum 248°C (478°F).

(3) FUEL BOOST PUMPS.—When power has been reduced, and 1,000 feet has been obtained, turn boost pumps off ,close intercoolers.

11. FLYING CHARACTERISTICS

a. CONTROL RESPONSE—Large airplanes are usally slower in responding to the pilot's controls, but in spite of its large size and weight, the B-29 has about the same flying qualities as smaller airplanes. Just after taking off, and again during the short interval of time while landing, the rudder and aileron control response is slow but very positive, giving little, if any, impression of sluggishness or lack of control. There is more travel in the control wheel of the B-29 than in the B-17.

(1) The effect of unequal amounts of fuel in the two sides will be noticed in the aileron control when flying straight and level. As speed decreases to near the stall, the amount of aileron needed to offset the unevenness will grow very rapidly. Don't attempt landing with this unevenness until the aileron control is checked in flight at landing speed.

(2) The elevators are well balanced and the leading edge of the tail airfoil section is turned up so the tail won't stall when making a power-on approach to landing with the flaps full down. The elevator trim tab is very sensitive at high speeds.

(3) Do not be confused by the very light forces on the rudder, since the forces alone don't tell what the rudder is doing to the airplane. In landing approach conditions it is possible to get appreciable amounts of skid with very small effort. Remember that it takes a certain amount of time to skid a large airplane, and also to stop a skid.

b. CHANGING POWER CONDITIONS.—In order to know how the power needed to fly changes as the speed changes, it is necessary to understand how an airplane uses power. Assume that an airplane is in level flight. It requires power to keep flying. Some power is used just to keep the airplane afloat in the air. The second part of the power pulls the airplane through the air. These portions change as the airplane changes its speed. When it is flying slowly, a lot of power is used to support the airplane and very little of it is used for moving. Then as the speed increases, less power is used to keep the airplane in the air and more power goes into pulling the airplane. Charts A, B, and C are curves drawn to show these effects.

(1) The power required curve in Chart D, shows that after the speed gets fairly high, raising the power will raise the speed. At low speeds (below 170 MPH, IAS for the B-29), it is possible to use more power and yet get less speed. It is easy to fly for hours on the "back side of the curve" when this happens. It takes

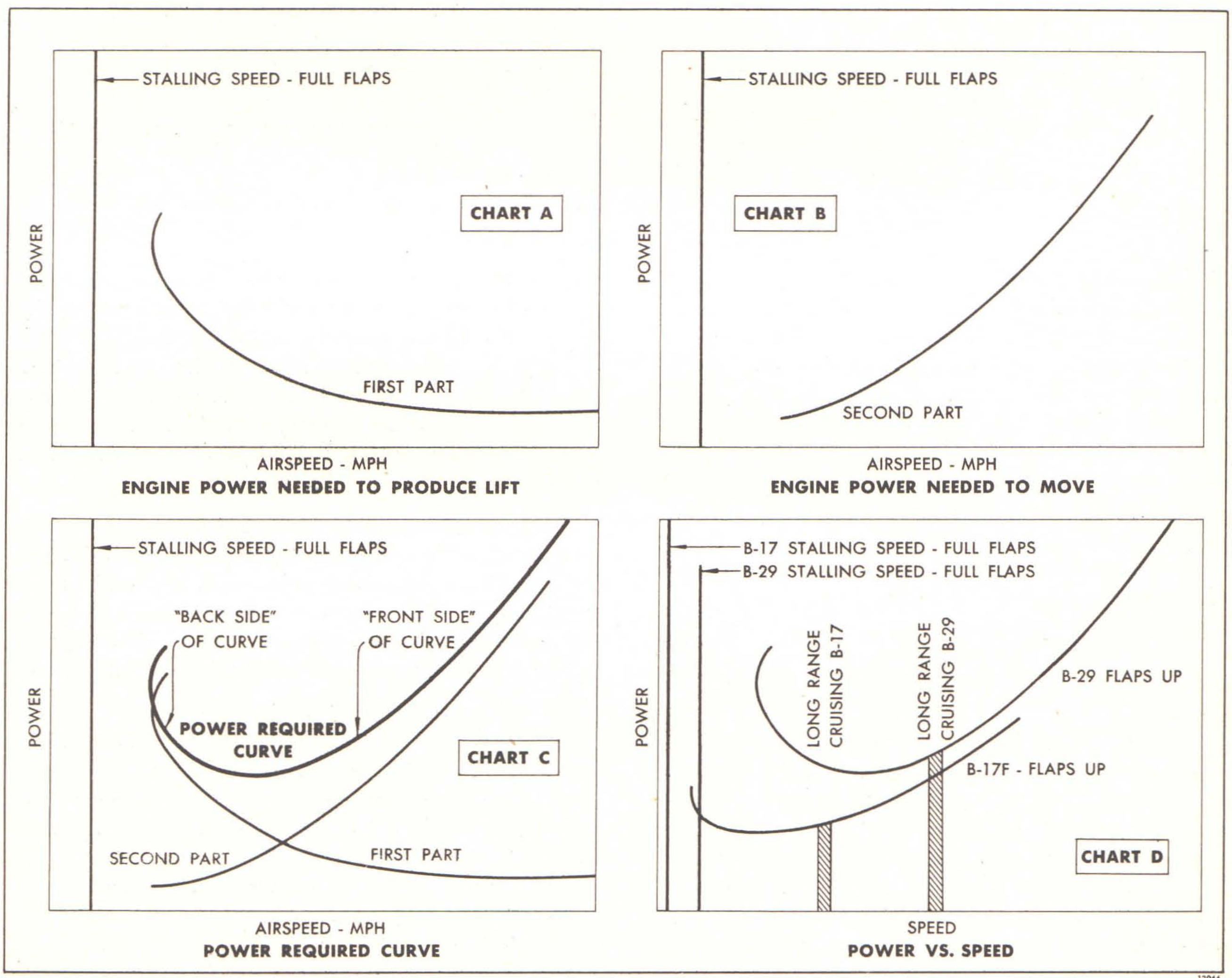


Figure 41 — Performance Curves

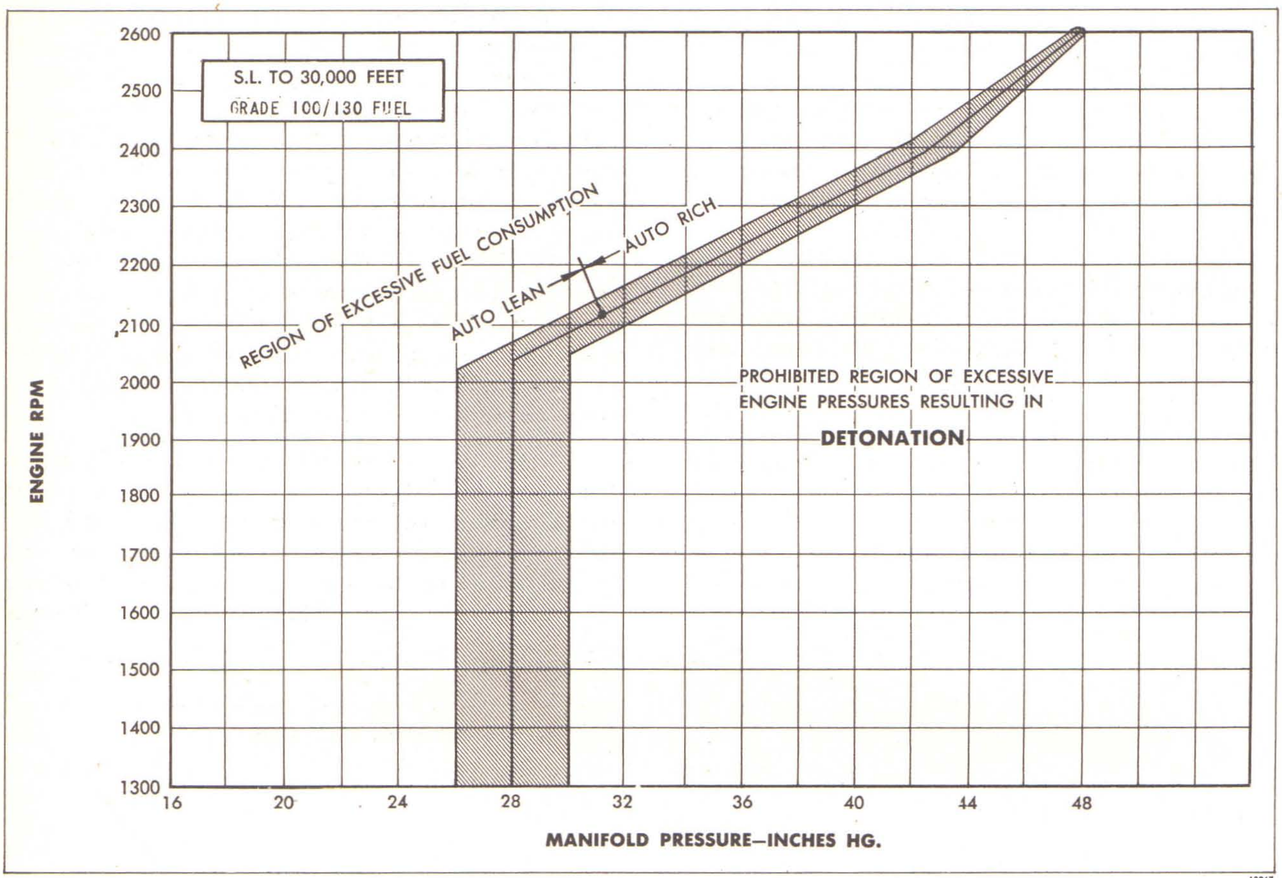


Figure 42 — Engine Operating Limits

only a momentary drop of the airplane's nose to boost the speed 20 to 30 MPH, IAS with the same power.

(2) Sometimes pilots have had trouble in rough air when they tried to hold the altitude constant when flying near the bottom portion of the curve. The speed changed 20 to 30 MPH, IAS. They were flying first on the "front side" and then on the "back side" of the curve. If they had held the speed constant, instead of the altitude, flying would have been easier and the altitude would not have changed too much.

(3) More power is required to fly when the airplane's weight increases. Adding 100 pounds requires from 2 to 3 more horsepower to fly the B-29 level at a set speed in the medium speed range. One more horsepower per 100 pounds is needed at higher flight speeds.

(4) The effect of altitude on the speed and power combination must also be recognized. If the power is held constant, the level flight speed will drop off at the rate of 1½ MPH, IAS for each 1000 feet increase in altitude but the true airspeed will increase 1%.

c. ENGINE OPERATING LIMITS.—In the "Region of Excessive Fuel Consumption" chart, figure 42 (region on left hand side), the manifold pressure is too low for the given RPM. The power plant efficiency decreases in this region as it is operated farther from the recommended settings. The lower the manifold pressure or the higher the RPM for a given power, the greater will be the quantity of fuel used to produce a given power. This region is not critical in that there is no danger of damaging the engine unless engine speeds in excess of the highest on the chart (2600 RPM) are used. The approach to landing is usually made in this region.

(1) In the region to the right of the "Desirable Region" described as the "Region of Excessive Engine Pressures," the manifold pressure is too high for a given engine RPM. Engine damage as well as severe loss of efficiency is the danger of this region, and detonation (possibly with pre-ignition) is usually the direct cause of this damage.

d. TURBOSUPERCHARGER — USE AND LIMITATIONS.—With the turbosupercharger boost controls installed on the B-29 a governor automatically limits the turbo speed to 26,400 RPM. There is no region of turbo overspeed for any altitude. The turbo continues to turn faster at higher altitudes at any given power, and at 33,000 feet the turbo speed at military power is 26,400 RPM. If altitude is increased above 33,000 feet the boost control will prevent the turbo from turning any faster by automatically reducing

manifold pressure approximately 1½ inches per thousand feet.

(1) There is no need for the pilot to decrease manifold pressure at altitude to prevent turbo overspeed if the boost control is working properly. However, it is well to know what the control is supposed to do. If military power manifold pressure (47.5 inches) is indicated above 33,000 feet (rated power 43.5 inches MP at 35,000 feet), the control is not working properly. Since the consequences of serious turbo overspeed might be explosion of the turbos, perhaps damaging the front wing spar or puncturing a fuel tank, the crew should recognize faulty boost operations and correct it by reduction of manifold pressure with the throttles. Trying to use the calibrating screw for reduction of manifold pressure will likely be entirely ineffective. Probably no malfunctions would originally occur if the individual boost system would respond to the calibrating screw.

(2) Malfunction of any boost control will most likely be noticed in the climb when that engine holds its manifold pressure as the others start dropping off at about 35,000 feet (at rated power).

e. WING HEAVINESS.

(1) Check trim tab position indicator.

(2) Check for equal fuel quantity in left and right wings.

12. STALLS

a. STALL CHARACTERISTICS.—The stall characteristics of the B-29 airplane are entirely normal. As the stall is approached, a very noticeable lightening of the elevator loads will occur. It will be necessary to move the controls an appreciable amount to get a response from the airplane. Just before the full stall is reached, a shuddering and buffeting of the airplane will occur. The airplane will recover from the stall very normally and no excessive wing dropping will be encountered when the stalls are properly controlled. Power reduces the stalling speed but, in general, has no large effect upon the stall. Never fly below the power-off stalling speed since any loss in power when flying below this speed is liable to stall the airplane. Very violent stalling of the airplane might be encountered during these conditions. On all landing approaches, extreme care should be taken never to allow the speed to fall below the power-off stalling speed. It might be well to try power-off approaches whenever possible in order to become familiar with the airplane under emergency conditions. Power should never be used in order to reduce the landing speed.

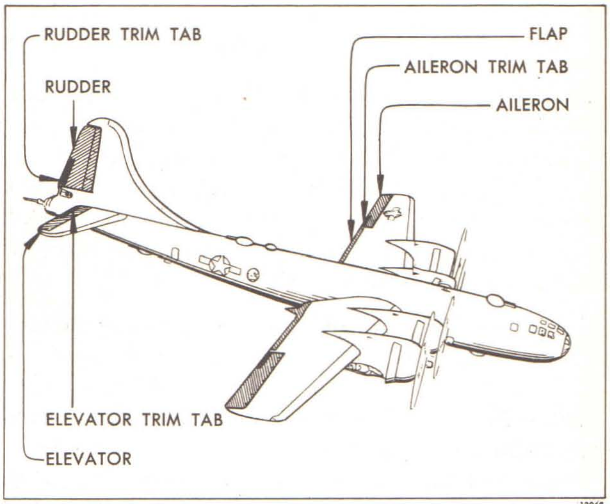


Figure 43 — Control Surfaces

b. RECOVERY FROM STALL.—When the airplane is stalled, recovery should always be made by nosing the airplane down. This should then be followed with more power. However, never apply power at the stall without dropping the nose at the same time. In most airplanes, it is possible to obtain a very high rate of descent in a power-stall by applying power during the power-off-stall without dropping the nose. These conditions must be avoided in the B-29.

c. POWER OFF STALLING SPEEDS.

GROSS WEIGHT	INDICATED STALLING SPEEDS		
	Flaps up	Flaps 25°	Flaps Full
140,000	145	131	119
130,000	140	126	114
120,000	135	121	110
110,000	129	115	105
100,000	123	110	100
90,000	117	104	95
80,000	110	98	89
70,000	103	92	84

d. PRECAUTIONS.—Do not stall the airplane with more than 15 inches Hg., nor more than a 10-degree cowl flap setting. Do not stall the airplane with unbalanced power.

13. CRUISE

a. PILOT'S AMPLIFIED CHECK

(1) RELATED POWER SETTINGS.—For each RPM setting, whether climbing or cruising, there is a definite manifold pressure setting. Using more manifold pressure leads to detonation; using less manifold pressure wastes fuel. Form the habit of using related power settings at all times and control your cylinder head temperatures with air speed.

(2) ON THE STEP.—Before cruising, climb above desired altitude (500 feet above for altitudes from 0 to 10,000 feet; 1,000 feet above for altitudes from 10,000 to 20,000; 1500 feet above for altitudes of more than 20,000 feet), then hold climbing power settings at zero rate of climb until reaching 210 MPH. 210 MPH will put the airplane "on the step". Then set predetermined cruising power setting, nose the airplane down slightly, open cowl flaps to 10 deg. and descend to desired altitude at 210 MPH. When reaching desired altitudes, close cowl flaps to 3 deg. and use elevators to hold predetermined cruising air speed. Vary power settings slightly to maintain altitude. After air speed is established, cowl flaps may be opened or closed individually to maintain cylinder head temperatures within limits. Always reduce manifold pressure first, then reduce RPM, to avoid excessive brake mean effective pressure.

(*a*) The B-29 will not reach its maximum air speed for a given power setting unless it is flown "on the step". By setting cowl flap openings as low as possible, by closing intercooler flaps as soon as turbos are "OFF," and by flying "on the step," you should cruise at indicated air speeds running from 180 to 210 MPH, depending on your gross weight.

b. ENGINEER'S AMPLIFIED CHECK

(1) When the airplane is climbing to get above desired altiture, hold climb power until a speed of 210 MPH is reached. When pilot noses down slightly, open cowl flaps to 10 deg. and maintain 210 MPH with predetermined cruise power to cool cylinder heads. When reaching cruising altitude, and airplane levels out, close cowl flaps to 3 deg. When airplane is on the step, adjust cowl flaps to keep cylinder head temperatures slightly below 232°C. (450°F).

(2) INTERCOOLERS.—Turbos "ON", adjust as required to maintain lowest carburetor air temperature. If icing is encountered, maintain 25° to 38°C (77° to 100°F).

(*a*) Turbos "OFF", intercoolers closed.

(3 MIXTURE CONTROL—Auto rich above 2100 RPM and 31 inches Hg. Auto lean at 2100 RPM, 31 inches Hg. and below. No manual leaning from either "AUTO LEAN" or "AUTO RICH" is to be attempted.

(4) FLIGHT LOG.—At any major power change, or at weight change (2 hour intervals), make entries in flight log and compute cruise control data.

Note

On 3-engine operation add 11-15% fuel for auto lean and 22-25% for auto rich, to compensate for propeller drag, airplane yaw and trim and added cowl flap drag.

c. CRUISING CHARTS.—A few charts relating to cruising are in a preceding paragraph titled "Flying Characteristics". Additional charts with more complete data are in Appendix III.

14. AUTO PILOT

a. HOW TO ENGAGE THE C-1 AUTO PILOT

(1) BEFORE TAKE-OFF.

(*a*) Unless the knobs on the Auto Pilot Control Panel are known to be properly adjusted, turn them to "POINTERS-UP" position.

(*b*) Center "TURN CONTROL", and make sure that control transfer knob is at "PILOT".

(*c*) Engage Auto Pilot clutch by turning knob clockwise.

(*d*) Disengage bombsight clutch by pulling clutch lever toward you.

(2) AFTER TAKE-OFF

(*a*) Turn "ON" master and Stabilizer switches connected by bar.

(b) After five minutes, turn on PDI Servo switch on the Auto Pilot Control Panel.

(*c*) Turn "ON" tell-tale lights or open shutter.

(*d*) After leveling off at cruising altitude, "get on the step" and trim airplane for straight and level flight.

(*e*) After master switch has been "ON" for ten minutes (to be sure gyros are erect) center PDI by either of the following methods:

Bombardier, disengage Auto Pilot clutch and center PDI by moving Auto Pilot clutch arm to its center position. Then lock it in place by depressing the Directional Arm lock.

Alternate: Pilot, center PDI by turning airplane in direction of PDI needle. Then, with PDI centered, resume straight-and-level flight.

(*f*) With wings level, adjust aileron centering knob until both aileron tell-tale lights go out. Immediately turn aileron switch "ON."

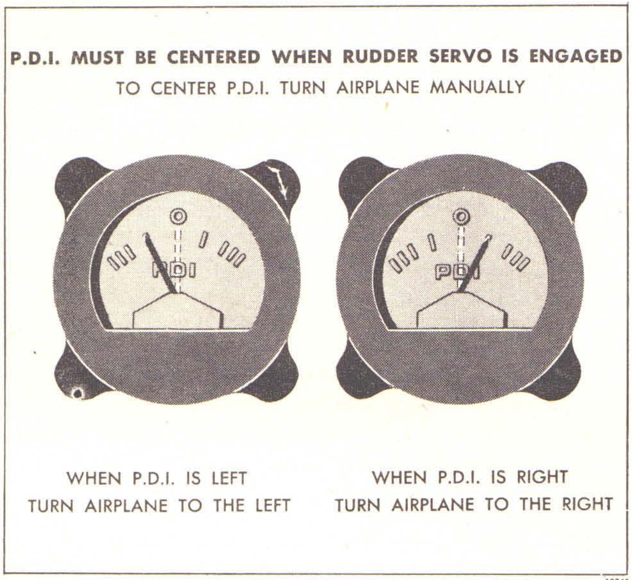


Figure 44 — Centering PDI by Turning Airplane

(g) With PDI on "ZERO," adjust rudder centering knob until both rudder tell-tale lights go out. Immediately throw rudder switch "ON."

(h) With airplane flying level, adjust elevator centering knob until both elevator tell-tale lights go out. Immediately throw elevator switch "ON."

(i) Observe PDI, Artificial Horizon and Rate-of-Climb or Altimeter instruments, and then carefully retrim all centering knobs until airplane is flying as straight and level as possible, with PDI on center.

(j) With Autopilot clutch engaged and bombsight clutch disengaged, all course corrections must be made only with Autopilot Turn Control. Always turn knobs with a slow, steady movement.

(k) After the Autopilot is in operation, the pilot should carefully analyze the action of the airplane to determine which control surfaces may not be operating properly.

(3) FLIGHT ADJUSTMENTS.

(a) GENERAL. — Control knobs are provided on the Autopilot Control Panel to permit precise adjustment of its operation for maximum efficiency under any flight or load-carrying condition. Once these adjustments have been set for a particular airplane, only slight readjustments will be required each time the Autopilot is used—unless, of course, flight or load conditions change considerably.

(b) CENTERING.—The centering controls on the Autopilot Control Panel are comparable to the trim tabs of the airplane. They control the normal attitude of the airplane while the Autopilot is in operation. When flying under Autopilot control, use centering knobs in place of the mechanical trim tab controls to compensate for slight changes in air speed, CG, or gross weight. When large changes in air speed, CG, or gross weight occur, it is necessary to disengage the Autopilot, retrim mechanically, and re-engage as before.

(c) SENSITIVITY. — The sensitivity knobs control the alertness of the Auotpilot, which is comparable to a human pilot's reaction time.

CAUTION

Never operate trim tabs and Autopilot simultaneously.

(e) TURN COMPENSATION. — Immediately after engaging the system and making sure sensitivity and ratio are well adjusted, the pilot will check and turn Compensation adjustments as follows:

1. Have bombardier disengage Autopilot clutch and move the clutch arm slowly to extreme right or extreme left.

2. Adjust aileron compensation control to produce an 18-degree bank, as indicated by the Artificial Horizon.

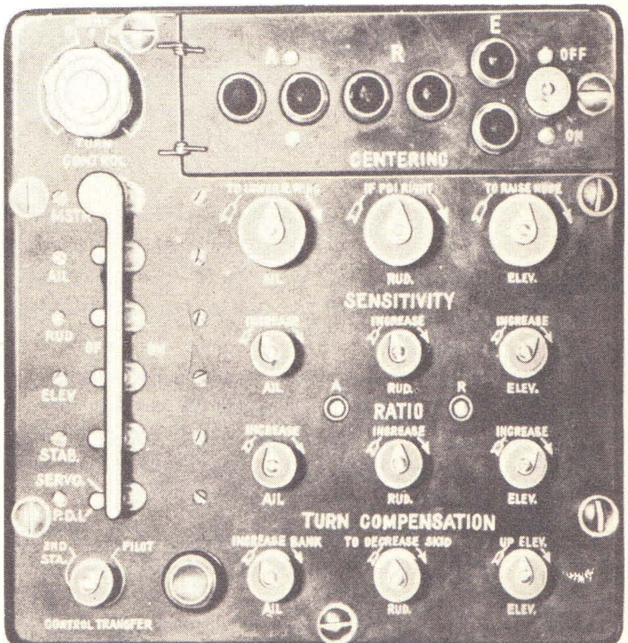


Figure 45 — Automatic Pilot Control Box

3. Adjust rudder compensation to produce a perfectly coordinated turn, as indicated by the Turn and Bank Indicator. Ball must be in exact center.

4. Make final adjustments with both knobs to obtain a perfectly coordinated turn with 18-degree bank.

5. Adjust up-elevator trimmer sufficiently to maintain altitude during the turn.

6. Have bombardier re-engage the Autopilot clutch at its extreme position, and allow the Stabilizer to recenter PDI.

(4) TURN CONTROL ADJUSTMENT.—The Turn Control offers the pilot a convenient means of changing the airplane's heading while flying under Autopilot control. The Turn Control seldom requires readjustment. This adjustment is made only after the turn compensation adjustments outlined have been completed.

(a) Rotate Turn Control knob slowly, either to right or left, until pointer reaches the lined region of the dial or until you feel a distinct resistance to further rotation.

(b) At that setting, adjust the aileron trimmer on the ACP to produce a 30-degree bank as indicated by the Artificial Horizon.

(c) Adjust rudder trimmer to produce a perfectly coordinated turn, as indicated by the Inclinometer. Final adjustments are made with both trimmers.

(d) Slowly return pointer to zero and hold it there while airplane resumes level flight.

(e) When airplane has leveled off, recenter Turn Control pointer.

CAUTION

Pilot must never operate Turn Control without first making sure PDI is centered and bombardier is not making a turn with the Autopilot Clutch.

(5) TURN CONTROL OPERATION.—Whenever it is desired to turn the airplane to a new heading while flying on Autopilot control, the pilot can execute the turn by an easy manipulation of the Turn Control.

(a) Rotate Turn Control slowly in the direction of turn desired. As the pointer passes the zero mark he will feel a "click" as the switch in the control closes, energizing the erecting cutout and Directional Arm Lock.

(b) Stop rotation of knob when Artificial Horizon indicates airplane has reached desired degree of bank.

(c) A warning stop causes the knob to turn with increased difficulty after the signal for a 30-degree bank has been applied. This is to warn the pilot to "take it easy" as he is approaching the maximum degree of bank obtainable (40 degrees). A steeper bank may cause the Vertical Flight Gyro roller spindle to strike against its stop on the gyro cover, resulting in precession.

(d) As the airplane approaches the desired new heading, slowly rotate control knob back to zero, timing this return so the pointer will reach zero when the desired heading is attained.

(e) Hold the pointer at zero until the airplane has leveled off on its new heading, then recenter the pointer to re-engage the erecting roller and release the Directional Arm Lock. (No signal is applied by Turn Control when pointer is at either zero mark.)

(6) OPERATION OF THE CONTROL TRANSFER.—The Control Transfer is in the lower left-hand corner of the control panel. This control enables the pilot to transfer control of the airplane smoothly to the remote Turn Control which is operated in an identical manner by the bombardier. The pilot rotates the Control Transfer knob to its extreme clockwise position. This is done slowly to prevent the sudden introduction of a strong signal in case the remote Turn Control is not centered at the time of transfer. (Never leave transfer knob at an intermediate position.) An indicator light adjacent to the Control Transfer knob informs the pilot when the remote Turn Control is in control of the airplane.

(7) DASHPOT ADJUSTMENT.—The dashpot produces an extra initial rudder correction signal proportional to the speed of turn axis deviation. This action is required for proper rudder control. Incorrect dashpot adjustment produces a tendency for the airplane to "wallow" or "rudder hunt" even with sensitivity, ratio, and turn compensation properly adjusted.

(a) TO CORRECT DASHPOT ADJUSTMENT.

1. Unlock dashpot adjustment by turning lock nut lever counterclockwise.

2. Turn knurled nut up or down until hunting ceases.

3. Lock adjustment by turning lock nut lever clockwise.

(8) PILOT'S FLIGHT PRECAUTIONS.

(a) Before maneuvering always turn off the Autopilot at least 10 minutes before attempting any extreme maneuvers, to allow time for gyros to slow down. If banks greater than 40 degrees are attempted with gyros running near rated speed, the gyros will be damaged by the violent precessing caused by striking their stops.

(b) CHECK DURING FLIGHT. — During a straight flight of several hours duration, it is advisable to check the airplane's course at regular intervals to determine whether precession of the Directional Stabilizer gyro has caused the airplane to deviate from its established heading. This precession is caused by the rotation of the earth and the curvature of its surface. When this phenomenon occurs, it is necessary to use the Turn Control to bring the airplane back to its proper heading.

(9) BOMBARDIER'S DUTIES—AUTOPILOT.

(a) Disengage the bombsight clutch and engage the Autopilot clutch before take-off.

(b) Disengage Autopilot clutch and hold PDI centered while the pilot is engaging the aileron and rudder Servo Units; then re-engage Autopilot clutch when engaging of the units has been completed.

(c) Operate Autopilot clutch arm to check adjustment of turn compensation.

(d) Make necessary dashpot adjustments during flight.

(e) Adjust Stabilizer mount to keep Directional Stabilizer level when airplane is in straight-and-level flight.

(f) Open the ventilating cover on the top of the Stabilizer housing as required to prevent overheating during flight.

15. INSTRUMENT FLYING

a. TAKE-OFF.—It is important when making an instrument take-off, and immediately thereafter, to hold the plane at the proper attitude and let the airspeed build up steadily. Hold zero rate of climb until you have reached 195 MPH with gear and flaps up.

b. RECOMMENDED FLYING SPEED.

(1) Take-Off	115-130 IAS
(2) Climb	195 IAS
(3) Landing Approach (25° flaps)	150 IAS

c. LANDING APPROACH.—When you are making an instrument approach and heading inbound toward the cone, set the flaps at 25 degrees, put the gear down, set the engine RPM at 2400, and put the turbo on "8". The airplane is relatively unstable with the flaps down; thus, it is recommended that flaps (25°) be used when starting to let down toward the cone, before beam bracketing becomes difficult and before changes in altitude become critical. It is also recommended that full flaps be saved until after you have broken through and are lined up with the runway on final approach.

16. BEFORE LANDING:

a. PILOTS' AMPLIFIED CHECK

(1) Notify Crew—Prepare for Landing.

The before landing check starts about 10 minutes before landing. For transition missions, take-offs should be spaced 45 minutes apart so landing gear retracting mechanism will cool. The Airplane Commander announces, "Prepare for Landing." Copilot repeats the command over the interphone, at which time Tail Gunner starts the put-put and informs the copilot. Crew members acknowledge in the following order: Bombardier, Navigator, Flight Engineer, Radio Operator, Top Gunner, Left Gunner, Right Gunner and Tail Gunner.

(2) Radio Call Completed.

The airplane Commander calls the tower for landing information.

(3) Altimeters Set.

Airplane Commander and copilot set their altimeters to the altimeter setting given by the tower.

(4) Trailing Antenna In.

(5) Auto Pilot Off.

(6) Turrets Stowed.

(7) Hydraulic Pressure OK.

The Copilot meters the brake pedals till pressure falls below 800 PSI and checks to see that pressure is returned to 1000 lbs. per sq. in. Any difference in final pressure should be reported to the Flight Engineer, as Copilot asks him to check emergency hydraulic pressure.

(8) Put-put on the Line.

The Copilot checks with the Tail Gunner to make sure that the put-put is on the line.

(9) Propellers 2400 RPM.

The Copilot adjusts propellers to 2400 RPM before Airplane Commander reduces power.

(10) Landing Gear Down and Lights On.

The Copilot on command of the Airplane Commander lowers the landing gear. The side gunners check the main gear and announce in order, "Left Gear Down and Locked" and "Right Gear Down and Locked." The Copilot checks the nose wheel through the observation window in the floor of the cockpit and checks the landing gear warning lights on his instrument panel.

NOTE: The indicated air speed MUST BE LESS than 180 MPH before the gear is lowered.

This visual check by the gunners and Copilot is most important. The red warning light and the green down and locked lights (and the landing gear warn-

ing horn, on early models) all operate from the gear motor limit switches. Remember this—the lights and the horn are *not* position indicators. They mean only that the limit switches have stopped the operation of the gear motors. If the switches open the circuit too soon, the gear will be only partly down and warning of this danger can come only from the visual check. The gear will support the weight of the airplane if the retracting screw is not more than 4 inches from the full down position (the screw itself retracts as the gear lowers.)

(11) Engineer's Report.

The Flight Engineer gives the weight and C.G. figures to the Copilot.

(12) Stall Speed.

The Copilot finds the stalling speed based on the weight by referring to the table mounted on his instrument panel and informs the Airplane Commander.

(13) Wing Flaps.

At the Pilot's command, the Copilot extends the wing flap 25 deg. just before turning on base leg. Later, on the final approach and at the Pilot's command, he extends full flaps at which point the airplane Commander retrims the elevators. The side gunners check position of flaps and inform the Copilot over the interphone.

(14) Turbos on No. 8.

Airplane Commander will call for Turbos on base leg. Copilot will announce "TURBOS ON" to Flight Engineer and turn Selector Dial to "8".

b. ENGINEER'S AMPLIFIED CHECK.

(1) Weight and C.G. — Engineer will compute weight and C.G. (% MAC) and give to Copilot.

(2) Mixture control—put mixture in "AUTO—RICH."

(3) Auxiliary power plant—start and warm up, put generator to run position and equalizer on.

(4) De-icers "OFF."

(5) Anti-icers "OFF."

(6) Fuel boost pumps "ON."

(7) Intercoolers—open for landing when turbo is put on.

(8) Cowl flaps—when airspeed is slowed 175-180 to lower gear, set cowl flaps to 7½ deg. to obtain 150-160 deg. cylinder head temperature for landing.

(9) Hydraulic pressure — inform Copilot emergency pressure is 900-1075.

(10) Report—inform Pilot, check list complete, ready for landing.

c. FINAL APPROACH.

(1) Don't extend full flaps until you are lined up with runway and sure of making the field. Go-arounds are difficult only when full flaps are full down. After extending full flaps, maintain indicated airspeed of 30 MPH above the power-off stalling speed. Don't "chop" the power at any point on the approach.

(2) Long approaches are not necessary, even when landing on narrow runways (see traffic pattern), but the base leg will normally be placed farther out than for a B-17 or a B-24.

d. GO-AROUND.—The technique to be used for a refused landing is not complicated. Flaps should be raised from full-down position to 25° immediately after full power is applied. Continue on the same approach angle until a safe flying speed is reached. Raise gear as soon as it becomes apparent that the runway will not be touched. Flaps and gears should be raised together if at least 3 generators are functioning. Raising the flaps immediately to 25° is of paramount importance rather than waiting for a "safe airspeed" as a "safe airspeed" will never be reached as long as the flaps are full-down, due to the high flap drag and the reduced acceleration with the possible operation on three engines. A "go-around" should not be attempted on less than three engines.

e. CROSSWIND LANDINGS.—Although there is good aileron, rudder and elevator control throughout the landing approach, remember that the B-29, because of its weight and size, is slow to respond to control movements. When making a crosswind landing, lower the wing on the upwind side and then raise it just before the wheels touch by applying a little throttle to the outboard engine on the low side. Make fairly long approaches on crosswind landings to give ample time to make drift corrections.

17. AFTER LANDING.

a. LANDING ROLL.—Don't use your brakes more than necessary after the wheels touch the ground. On a long runway, let the airplane roll until it loses speed. Lower the nose gently at 90 MPH, and when nearing end of runway, apply brakes evenly and smoothly. Toward the end of the landing roll, the Copilot sets the Turbo Selector to "0," moves propeller control to "INCREASE" and throttles to 700 RPM for taxiing.

b. PILOT'S AMPLIFIED CHECK.

(1) HYDRAULIC PRESSURE. — Copilot checks normal pressure gage for reading between 800 and 1000 PSI.

(2) TURBOS "O" DIAL

(3) PROPELLERS IN HIGH RPM.

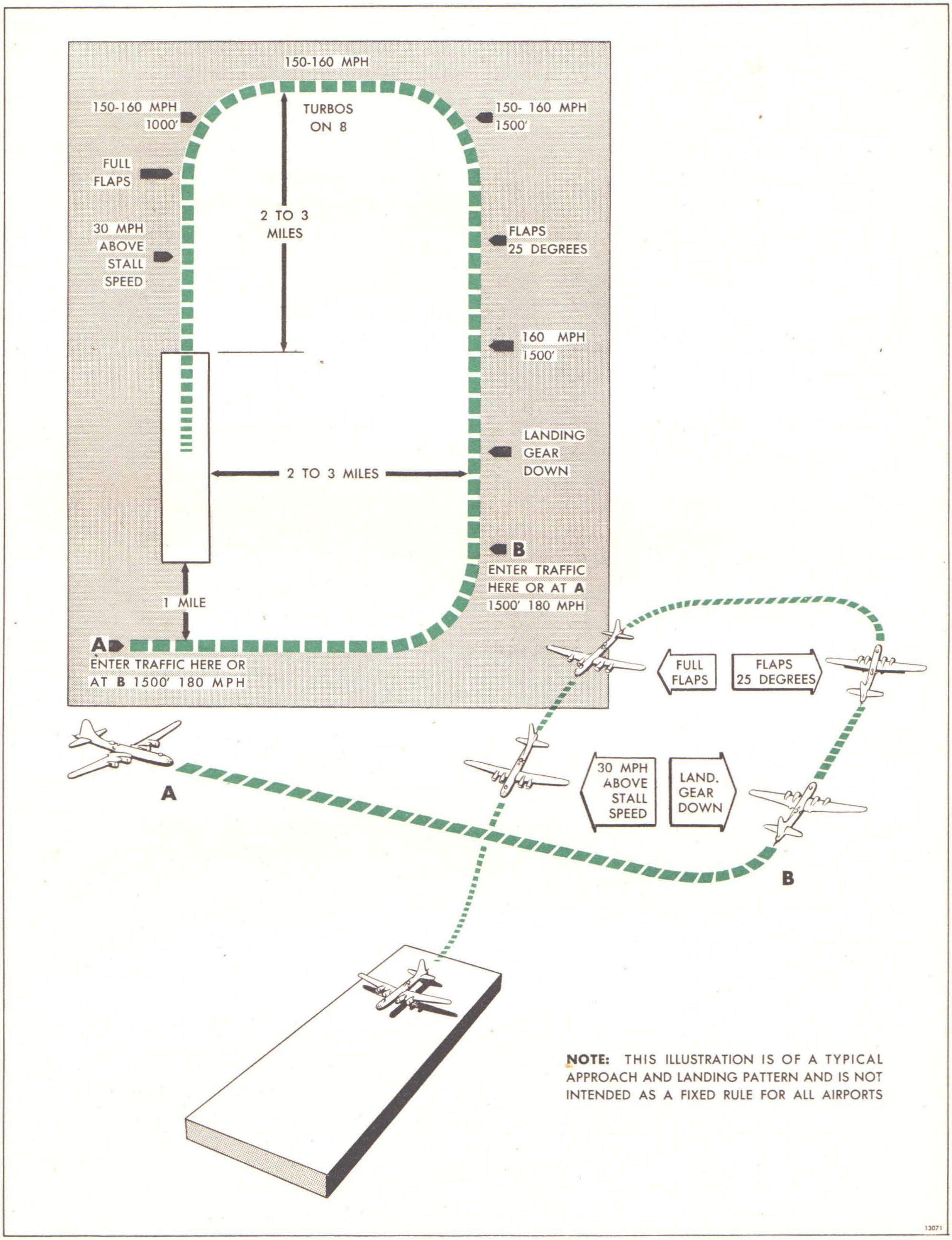


Figure 46 — Traffic Pattern

(4) WING FLAPS UP.—At the pilot's command, near the end of the landing roll, copilot raises flaps (all the way, if this is the last landing; to 25 degrees, if planning to make another take-off). Side gunners report on position of wing flaps.

(5) PARKING BRAKES SET (when sufficiently cool).

(6) BOMB BAY DOORS OPEN.—Pilot calls for bomb bay doors open. Copilot says to flight engineer, "Generator on coolest engine," and tells the bombardier to open the bomb bay doors. Flight engineer has meantime set throttle on coolest engine to 1400 RPM and turned generators on. The radio operator and one of the gunners check through the pressure doors and report to copilot that doors are open. Flight engineer returns throttle to 700 RPM when copilot says, "Generators off."

(7) MAGNETOS CHECKED.—The flight engineer checks all magnetos at 2,000 RPM.

(8) ENGINES STOPPED.—The pilot gives the order "Stop engines" to the flight engineer.

(9) RADIOS OFF.—The pilot turns off the command set and the copilot switches off the radio compass.

(10) CONTROLS LOCKED.

(11) WHEEL CHOCKS IN PLACE — BRAKES OFF.

(12) FORMS 1 AND 1A ACCOMPLISHED. — The flight engineer completes forms 1 and 1A and presents them to the pilot for check.

(13) CREW INSPECTION. — Crew members leave the airplane and line up as before to be checked by the pilot. At this time, defects in the airplane not already noted are reported to the flight engineer.

c. ENGINEER'S AMPLIFIED CHECK.

(1 & 2) COWL FLAPS AND INTERCOOLERS. —Upon landing, cowl flaps and intercoolers will be moved to full open position.

(3) GENERATORS.—Turn generators off.

(4) BOOST PUMPS.—Turn boost pumps off.

(5) BOMB BAY DOORS OPEN.—When copilot says, "Generators on coolest engine," flight engineer sets throttle at 1400 RPM and turns generators on. When doors are open and copilot says, "Generators off," flight engineer turns off generators and retards throttle.

(6) MAGNETOS.—Set throttles to 2000 RPM one at a time and check magnetos.

(7) STOP ENGINES.—Stop all engines simultaneously, using the following procedure:

(a) Run engines at 700 RPM until cylinder head temperatures cool (190°C or 374°F, if possible). While engines are cooling at 700 RPM, flight engineer flips master ignition switch to the "OFF" position momentarily to see that all magnetos are grounded out.

(b) Increase throttle settings to 1200 RPM and run each engine for at least 30 sec. at this speed.

(c) Move the mixture controls to idle cut-off.

(d) Turn "OFF" ignition switches after propellers stop turning.

(e) Order tail gunner to stop put-put.

(8) SWITCHES.—All switches "OFF."

(9) WHEEL CHOCKS IN PLACE.

(10) BRAKES OFF.

(11) CONTROLS LOCKED.

(12) FLIGHT LOG COMPLETE.

(13) FORMS 1 AND 1A.—Complete forms 1 and 1A and give to pilot for approval.

(14 & 15) TROUBLE SHOOTING.—Report all malfunctions to crew chief and help him locate the trouble.

18. AUXILIARY POWER PLANT.

a. CHECK LIST.

(1) BEFORE STARTING.

(a) FUEL.—Use grade100/130 fuel and fill tank to halfway up the filler neck.

(b) OIL. — Fill oil level to "FULL" mark on gage, use SAE No. 30.

(c) EMERGENCY SWITCH.—Place in "NORMAL" position.

(2) STARTING.

(a) ENGINE CONTROL LEVER. — Place in "IDLE" position. If temperature is below freezing, place in "CHOKE" position.

(b) IGNITION SWITCH.—Place in "ON" position as indicated by the light. (Ignition switch on the engine must otherwise always be in "OFF" position.)

(c) EQUALIZER SWITCH. — Place in "OFF" position.

(d) STARTING SWITCHES. — Hold the two switches to "START" with the hinged bar until the engine starts. Engineer's master and battery switches must be "ON." Release the switches to neutral and allow the engine to idle until the cylinder baffles are warm. (2 or 3 minutes).

(3) AFTER WARM-UP.

(a) ENGINE CONTROL LEVER.—Place in the "RUN" position.

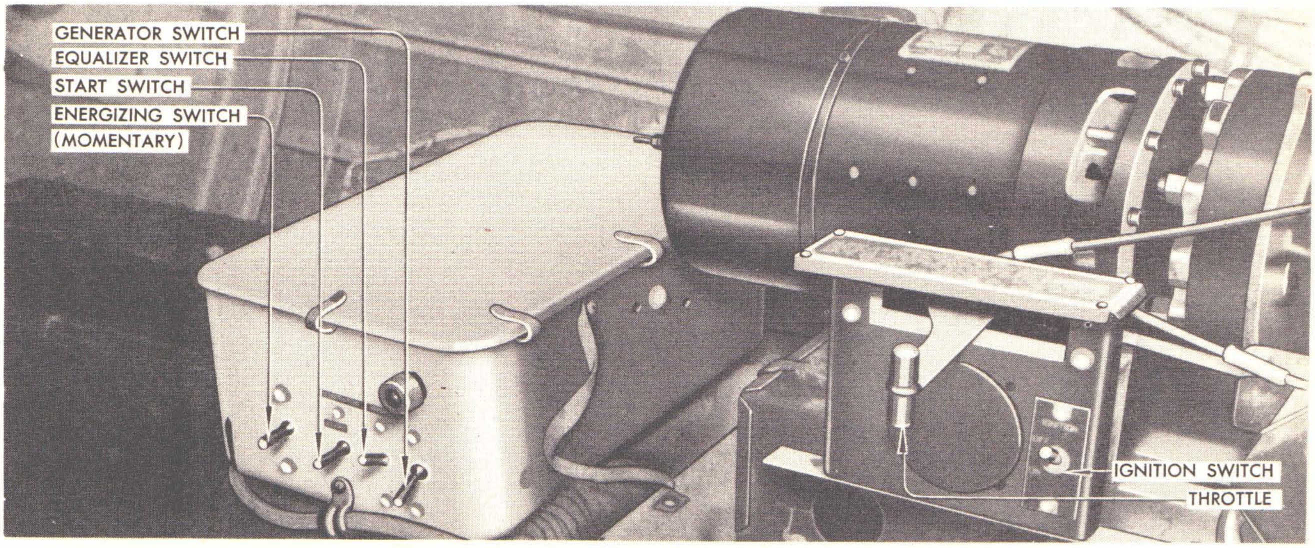


Figure 47 — Auxiliary Power Plant Controls

(*b*) STARTING SWITCHES. — Move both starting switches to "RUN."

(*c*) EQUALIZER SWITCH. — Turn "ON" if main engines are running, "OFF" if the main engines are not running.

(*d*) OIL PRESSURES.—Operating limits 45 to 75 PSI.

(4) STOPPING.

(*a*) STARTING SWITCHES. — Place both switches in "OFF" or neutral.

(*b*) EQUALIZER SWITCH. — Place in "OFF" position.

(*c*) ENGINE THROTTLE.—Place in "IDLE" position and allow the engine to run 2 or 3 minutes.

(*d*) IGNITION SWITCHES.—Place in "OFF" position.

(5) In stopping the Auxiliary Power Plant with the main engines running the two starting switches and the equalizer switch must always be turned "OFF" first, otherwise the voltage of the main generating system will be seriously lowered.

(6) If battery power to the ignition relay were to be interrupted by the fuse blowing out or a wire being severed, the relay would close and the power plant would stop. In this event the ignition switch on the engine should be turned "ON" and the power plant restarted.

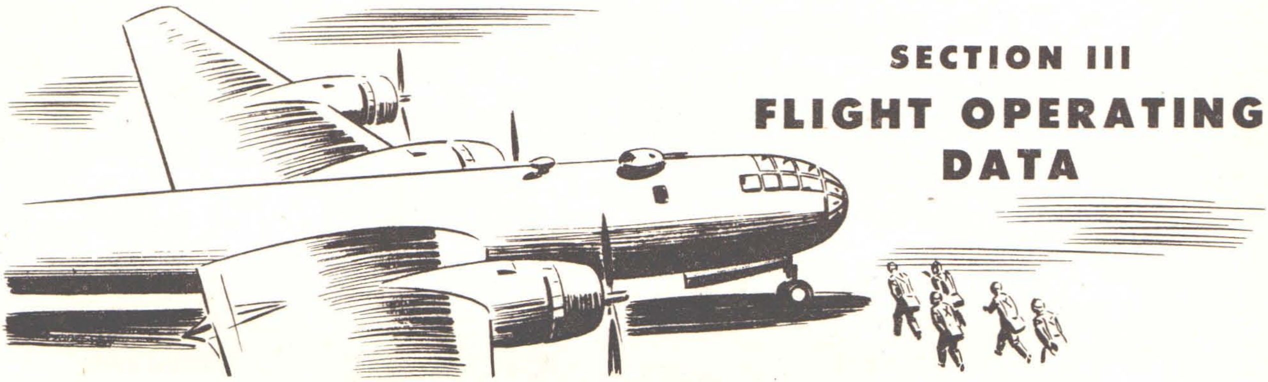
(7) Idling periods should be held to a minimum on the Ruckstell-Burkhart and Andover installations. Prolonged idling is believed to have caused failure of generator drive shafts due to vibrations induced in low speed operations.

19. FUEL SYSTEM MANAGEMENT.

See Figures 27, 28 and 29 for detailed operation of fuel transfer system. To transfer fuel, the engineer can use one or both of the fuel transfer pumps. One pump has a flow of 900 gallons per minute at sea level, 300 gallons per minute at 35,000 feet. Two pumps, in operation, double the rate of flow. To make the transfer, the engineer sets the fuel tank selector valves, turns the circuit breaker switch "ON" for the desired pump, and moves the pump switch toward the arrow pointing in the direction he wishes fuel to flow. If both transfer pumps are used, the pump switches must be deflected in the same direction; otherwise, one pump will work against the other; if the switches are left in opposite directions, the pump motors will burn out. To transfer fuel between tanks connected to the same transfer valve, transfer to a tank on the opposite valve and back to the desired tank. Methods for transferring fuel from bomb bay tanks to wing tanks vary according to auxiliary fuel system installations. The engineer should make sure he has the correct method of transferring fuel from bomb bay tanks for this airplane. Under no circumstances should he attempt to transfer fuel from wing tanks to bomb bay tanks.

20. AUXILIARY OIL SYSTEM.

A reserve oil supply is carried in some airplanes in a 100-gallon tank between the bomb bays in the fuselage. For control of the reserve oil system, there are three switches on the engineer's control stand and two selector valves on the front center wing spar to the left and right of the airplane centerline. The switches are oil heater, oil dilution and oil pump. Each selector valve has two outlet ports and an "OFF" position. For oil dilution, fuel is drawn from the No. 3 fuel booster pump through a solenoid operated valve into the reserve oil line ahead of the oil pump. The oil dilution switch operates the solenoid and the booster pump.



SECTION III
FLIGHT OPERATING DATA

INSTRUMENT AIRSPEED	CORRECT I.A.S. (25000 FT.)	ALTIMETER ERROR	
		15000′	30000′
160	156	40	67
180	175	51	85
200	194	62	105
220	213	76	127
240	232	90	151
260	251	105	178
280	269	122	206

13107

THE CORRECTED AIRSPEED INCLUDES PITOT POSITION AND COMPRESSIBILITY ERRORS.
7-1-44 THE INSTRUMENT READS 1 1/2 PER CENT HIGH DUE TO PITOT POSITION ERROR.

Figure 48 — Air Speed Correction Table

POWER PLANT CHART

AIRCRAFT MODEL(S)	PROPELLER(S)	ENGINE MODEL(S)
B-29 B-29A	6497A-6 Hamilton Standard Hydramatic	R-3350-13,21, 23, 23A

GAUGE READING	FUEL PRESS.	OIL PRESS.	OIL TEMP.	COOLANT TEMP.		OIL[1] CONS.
DESIRED MAXIMUM	17 19	75 80	50-70 95			29
MINIMUM IDLING	16 15	70 25				

MAXIMUM PERMISSABLE DIVING RPM: 3100
MINIMUM RECOMMENDED CRUISE RPM: 1400
MAXIMUM RECOMMENDED TURBO RPM: 26,400

OIL GRADE: (S) 1120 (W) 1120
FUEL GRADE: 100/130 Spec. AN-F-28

WAR EMERGENCY (COMBAT EMERGENCY)			MILITARY POWER (NON-COMBAT EMERGENCY)			OPERATING CONDITION			NORMAL RATED (MAXIMUM CONTINUOUS)			MAXIMUM CRUISE (NORMAL OPERATION)		
MINUTES			5 MINUTES			TIME LIMIT			UNLIMITED			UNLIMITED		
			260° C			MAX. CYL. HD. TEMP.			248° C			232° C		
			AUTO RICH			MIXTURE			AUTO RICH			AUTO LEAN		
			2600			R. P. M.			2400			2100		
MANIF. PRESS.	SUPER-CHARGER	FUEL[2] Gal/Min	MANIF. PRESS.	SUPER-CHARGER	FUEL[2] Gal/Min	STD. TEMP. °C	PRESSURE ALTITUDE	STD. TEMP. °F	MANIF. PRESS.	SUPER-CHARGER	FUEL GPH[3]	MANIF. PRESS.	SUPER-CHARGER	FUEL GPH[3]
						-55.0	40,000 FT.	-67.0						
						-55.0	38,000 FT.	-67.0						
						-55.0	36,000 FT.	-67.0						
						-52.4	34,000 FT.	-62.3						
						-48.4	32,000 FT.	-55.1						
			47.5		5	-44.4	30,000 FT.	-48.0	43.5		243	31		109
			"		5	-40.5	28,000 FT.	-40.9	"		245	"		110
			"		5	-36.5	26,000 FT.	-33.7	"		246	"		110
			"		5	-32.5	24,000 FT.	-26.5	"		247	"		110
			"		5	-28.6	22,000 FT.	-19.4	"		249	"		110
			"		5	-24.6	20,000 FT.	-12.3	"		250	"		110
			"		5	-20.7	18,000 FT.	- 5.2	"		250	"		109
			"		5	-16.7	16,000 FT.	2.0	"		250	"		108
			"		5	-12.7	14,000 FT.	9.1	"		250	"		108
			"		5	- 8.8	12,000 FT.	16.2	"		249	"		106
			"		5	- 4.8	10,000 FT.	23.4	"		247	"		105
			"		5	- 0.8	8,000 FT.	30.5	"		246	"		104
			"		5	3.1	6,000 FT.	37.6	"		245	"		103
			"		5	7.1	4,000 FT.	44.7	"		242	"		101
			"		5	11.0	2,000 FT.	51.8	"		239	"		99
			"		5	15.0	SEA LEVEL	59.0	"		234	"		97

GENERAL NOTES

(1) OIL CONSUMPTION: MAXIMUM U.S. QUART PER HOUR PER ENGINE.
(2) *Gal/Min:* APPROXIMATE U.S. GALLON PER *MINUTE* PER ENGINE (5% CONSERVATIVE)
(3) GPH: APPROXIMATE U.S. GALLON PER HOUR PER ENGINE. (5% CONSERVATIVE)
F.T.: MEANS FULL THROTTLE OPERATION.
VALUES ARE FOR LEVEL FLIGHT WITH RAM.

FOR COMPLETE CRUISING DATA SEE APPENDIX II
NOTE: TO DETERMINE CONSUMPTION IN BRITISH IMPERIAL UNITS, MULTIPLY BY 10 THEN DIVIDE BY 12. RED FIGURES ARE PRELIMINARY SUBJECT TO REVISION AFTER FLIGHT CHECK.

TAKE-OFF CONDITIONS:

2800 RPM 49 MP AUTO RICH 260°

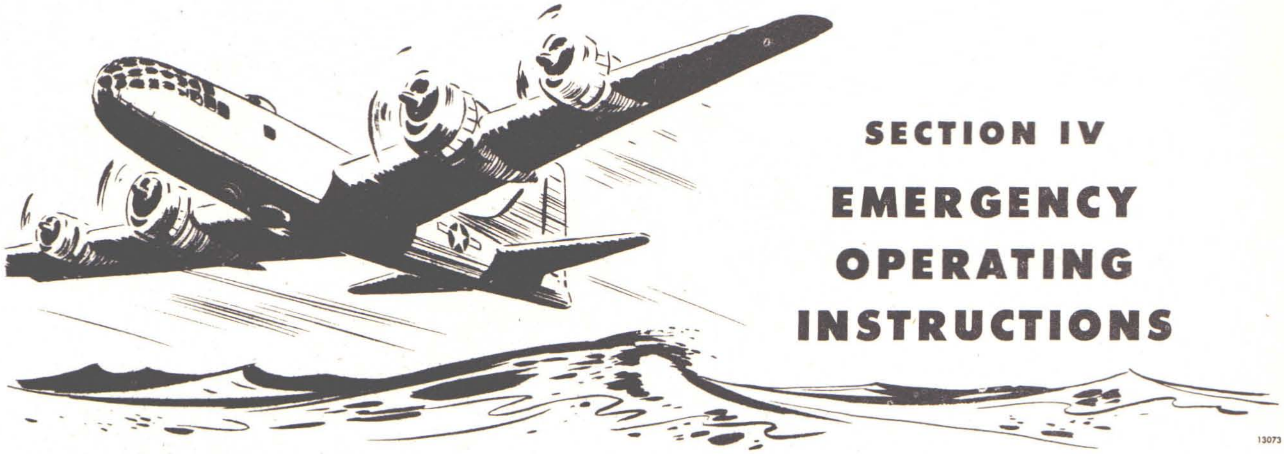
CONDITIONS TO AVOID:

SPECIAL NOTES

DATA AS OF 7-1-44 BASED ON FLIGHT TESTS

AAFMC-526
4-1-44

Figure 49 — Power Plant Chart



SECTION IV
EMERGENCY OPERATING INSTRUCTIONS

1. ENGINE TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Excessive head temperature	1. Exceeding limitations.	Adhere to limitations on power plant chart (figure 23). Keep cylinder head temperature below 220° C (428° F) before actual start of take-off run.
	2. Mixture too lean.	Check mixture control. Auto lean should not be used above 2100 RPM and 31 inches MP.
	3. Fuel pressure low.	Maintain fuel pressure between 15 and 19 PSI.
	4. Cowl flaps closed.	Maintain proper cowl flap openings. Never open cowl flaps more than 3½ inches (12°) in climb or 3 inches (10°) in level flight.
	5. Detonation.	Check propeller RPM; decrease manifold pressure, or use a richer mixture.
Incorrect manifold pressures	1. Turbo regulator.	Check manifold pressure selector control for proper operation, position, calibration.
High oil temperature	1. Faulty oil cooler operation.	Desirable oil temperatures should range between 50°C (122°F) and 70°C (158°F), max. 95°C (200°F). Open oil cooler flaps manually. In extremely cold weather close oil cooler flaps to relieve congealed oil.
Low oil pressure	1. High oil temperature.	Proceed as in high oil temperature.
Low fuel pressure	1. Altitude.	Use booster pump. Maintain fuel pressure at 17±2 PSI.

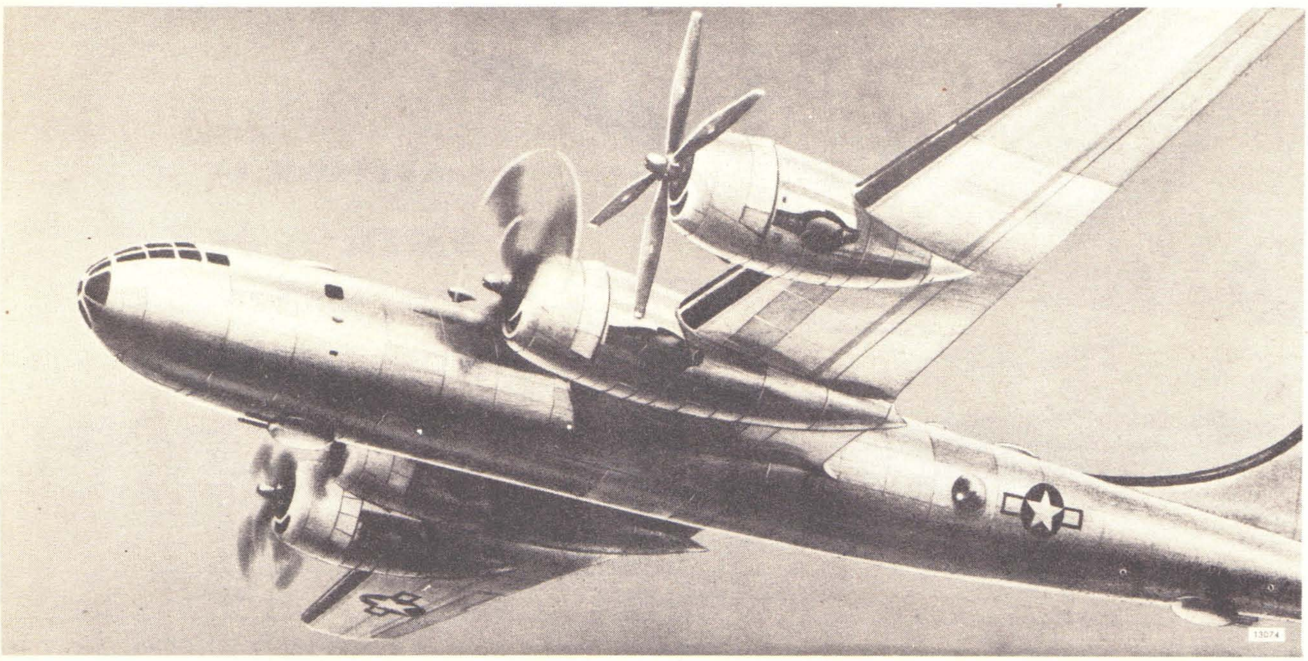


Figure 50 — Outboard Propeller Feathered

2. ENGINE FAILURE.

a. FAILURE OF ONE ENGINE.—Failure of an outboard engine is naturally more critical than failure of an inboard engine. In either case you need at least 120 IAS to manage the airplane. If at high gross weights the stalling speed is close to 120 IAS, an additional margin is necessary. When an outboard engine fails, there is an immediate loss of lift over the wing section behind the dead engine; there is the drag of the windmilling propeller, and there is a loss of thrust. As a consequence, the airplane acquires a tendency to yaw and roll. The first warning is a drop of the dead engine wing. If airspeed is too low, the control surfaces will not have enough effect to overcome the yawing and rolling tendency; the result will be an airplane out of control.

(1) TAKE-OFF.—Under no conditions is it considered desirable to take-off from a standstill with an engine inoperative or a propeller feathered. If an engine fails during ground run, do not leave the ground without an IAS of 120 MPH and the ability to clear all obstacles. If there is a runaway propeller on one engine at take-off, throttle down to reduce RPM below 2800, and thus get some help from the malfunctioning propeller. However, at 150 MPH, IAS, the runaway propeller will be dragging.

(a) If a turbo runs away at take-off reduce the manifold pressure of the affected engine to 40 inches Hg. with the throttle. Reducing the manifold pressure with the throttle will prevent turbo overspeed and permit sufficient power for take-off; reduction of the turbo boost setting would reduce the power of all engines.

(2) CLIMB.—If an outboard engine fails during a climb at a speed below 120 IAS, airspeed must be gained rapidly by nosing down, even through the airplane may still be close to the ground; partial throttling of the good outboard engine will help to retain control. When 120 IAS is gained, full power on the good outboard engine may be used. Any attempt to climb the airplane without proper airspeed will be disastrous. Retract the landing gear as soon as possible in all cases after the airplane has left the ground.

(3) TRIMMING FOR UNEVEN POWER.—Near take-off speed there is a range of speeds at which control of the airplane is difficult or nearly impossible if power is not the same on both sides. If high power is being drawn from three good engines with the fourth engine windmilling, the airplane will have a strong tendency to roll and yaw. The yaw will require the use of aileron for lateral trim. The airplane will then fly in a crabbing manner. By use of the rudder the airplane can be made to fly straight. As the airspeed decreases, the crabbing will increase and more rudder control will be necessary to correct this crabbing condition. At light gross weights and an airspeed of around 120 IAS full rudder will be needed just to stop the crabbing. If the airspeed drops below 120 IAS, it will be impossible to stop the crabbing, even with the rudder hard over. As crabbing gets worse, more and more aileron will be needed for lateral trim. At any speed below which full aileron and full rudder are used, the airplane will go into an uncontrolled roll; the roll can only be prevented by partial throttling of the good outboard engine or by increasing speed.

b. FAILURE OF TWO ENGINES.—It is possible to fly with two dead engines on the same side with good control down to 130 MPH, IAS at gross weights. The propellers on the two dead engines must be feathered. Only at a light gross weight will the airplane maintain altitude when two engines on one side are at rated power and two propellers on the other side are windmilling. The ability of the airplane to fly on two engines at military power is very limited at high gross weights. At 100,000 pounds it is just possible to maintain level flight on two engines with two propellers feathered and with the landing gear down and flaps in the approach position. It is therefore necessary to keep the drag of the airplane as low as possible.

c. LANDING WITH UNEVEN POWER. — The landing gear and flaps must not be extended for emergency landing until the landing is assured because the performance will probably be so marginal with one or more engines dead that only one try at landing can be made once the flaps and gears are down.

d. STALLING SPEEDS. — In general, airspeed should be kept at least 10 MPH, IAS above the power-off stalling speed when power is uneven; in no case should the airspeed drop below 120 IAS with uneven power. Lateral control cannot be expected to be good at stalling speeds. It is expected that this airplane, like any other airplane, will make very violent, possibly destructive maneuvers if it is stalled while flying with any appreciable amount of uneven power.

3. PROPELLER.

Think twice before you feather a propeller under emergency conditions such as engine failure on take-off or landing. Feather a propeller only when you are sure that the engine is creating a drag. Even an idling engine delivers some thrust at relatively low speeds. On take-off it may be delivering just enough to mean the difference between crash landing and going around. Even if a crash landing is inevitable, do not feather propellers. Balance the power and land straight ahead. The B-29 propeller feathering system uses engine oil pumped by an electric motor into the propeller dome. If all oil in the main system is lost, a three gallon oil reservoir holds enough oil for feathering, and unfeathering. (An airplane with this reservoir is easily identified. The feathering pump is located directly beneath the main oil tank.) If engine oil is lost, and the propeller cannot be feathered, the greatest danger is from the windmilling propeller, its speed depending on your altitude and airspeed. As an example, if you are operating on three engines at 25,000 feet and 233 MPH, true airspeed, and the dead-engine propeller is windmilling in low pitch, RPM will be about 4,000. Since high speeds can cause centrifugal explosion of the propeller or destruction of the engine, reduce your power and lose airspeed, using flaps and gear if necessary. At lower altitudes and very low speeds, the windmilling propeller is not likely to exceed the normal RPM limits.

a. RUNAWAY PROPELLER.—Throttle back when a propeller runs away. Keep down RPM by intermittently pushing in and pulling out the feathering button switch. (The switch has to be pulled out; otherwise it will not pop out until the propeller feathers.) Feather the propeller as soon as a safe altitude is reached. Sometimes, after the feathering button is used to keep down RPM, the governor will control the propeller, if the pilot is careful to avoid applying sudden power to the engine. In this case, do not feather the propeller. Handle the throttles carefully and come in for a landing as soon as possible.

b. NORMAL OVERSPEEDING. — Normal overspeeding of the propellers up to 3150 RPM caused by power surge should not be confused with a runaway propeller. An overspeeding propeller will normally be returned by the governor to the set speed within a few seconds.

c. FEATHERING.

(1) Throttle closed.

(2) Push feathering button and tell Flight Engineer to prepare for feathering. (Don't hold button down. It will pop out when propeller is fully feathered.)

(3) Fuel off (mixture, fuel boost, fuel valve).

(4) Auxiliary equipment (generators, cabin air valve, vacuum pump) off or transferred to another engine.

(5) Cowl flaps and oil cooler shutters closed.

(6) Ignition off when propeller stops turning.

(7) Retrim airplane for balance and power.

d. UNFEATHERING.

(1) Propeller control to low RPM.

(2) Push feathering button and hold until propeller reaches 600 RPM and not more than 1000 RPM.

(3) Fuel valve and fuel boost on—mixture auto rich.

(4) Warm to 150°C at 1200 RPM, then advance RPM and throttle.

4. RUNAWAY TURBO.

When a turbo runs away, throttle back; change the amplifier. The turbo amplifiers are mounted forward of the navigator's table.

5. EMERGENCY IGNITION CONTROL.

Two switches with linked toggles on the engineer's instrument panel open the battery circuit and ground all magnetos simultaneously in emergencies.

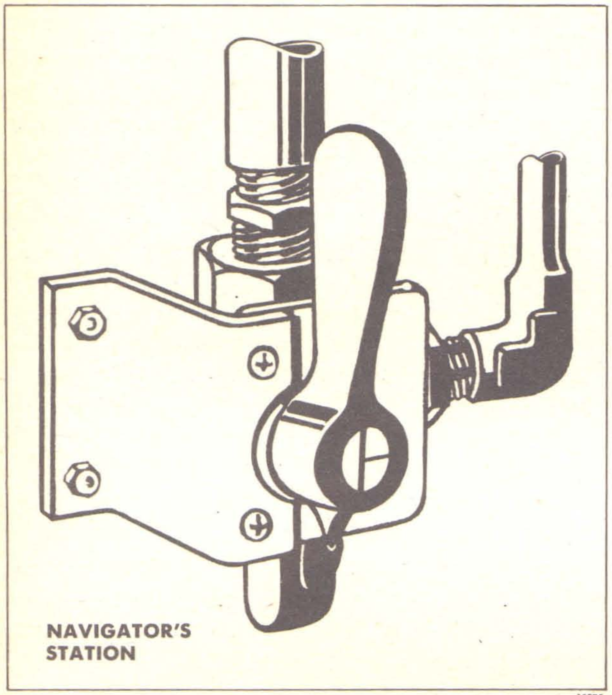


Figure 51 — Emergency Vacuum Shut-off Valve

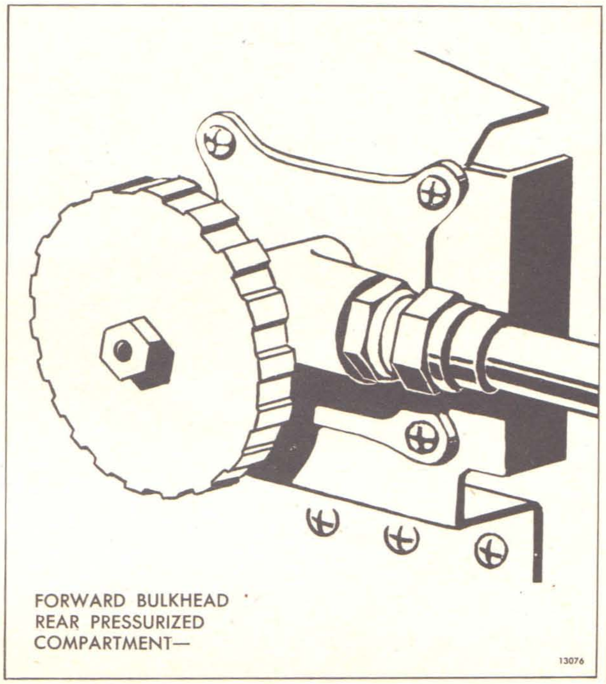


Figure 52 — Emergency Oxygen Valve

6. EMERGENCY VACUUM SHUT-OFF VALVE.

In the event of a de-icer shoe rupture or vacuum line failure the entire de-icing system and the camera vacuum lines may be shut off by closing the emergency vacuum shut-off valve, mounted on the navigator's filing cabinet. This does not affect proper functioning of the vacuum instruments.

7. EMERGENCY CONTROL OF CABIN PRESSURE.

If combat conditions are anticipated at high altitudes when the cabin is pressurized, the engineer, upon orders from the pilot, will relieve cabin pressure by means of the cabin pressure relief valve handle under the engineer's seat. Reducing cabin pressure will decrease the possibility of inside pressure rupturing the skin in event of shell fire. Each crew member should have his oxygen mask attached to the left side of his helmet at all times. Prior to the release of cabin pressure, crew members must be cautioned to adjust their oxygen masks, and, if equipped with electrically heated suits, to plug them in. Cabin pressure can be released quickly. To permit rapid escape of air from the pressurized cabin and allow the pressure bulkhead doors to be opened in an emergency, pull either of the two cabin pressure release handles. One is located on the pilot's control stand and the other on the right side wall of the rear pressurized compartment near the forward bulkhead. A sudden decrease of cabin pressure should not be harmful to personnel at altitudes below 30,000 feet; some crew members might experience temporary pain from the "bends" with a sudden release of pressure above 30,000 feet.

8. EMERGENCY OXYGEN VALVES

Oxygen is supplied by four groups of cylinders, two serving the forward compartment and two serving the two rear compartments. The two groups serving the forward system are interconnected by a line incorporating a valve located at the engineer's station. This valve is normally closed but it can be opened in emergencies to make both groups of cylinders available to all forward compartment regulators. The two groups of cylinders serving the rear compartments are similarly interconnected through a valve located in the forward end of the pressurized compartment.

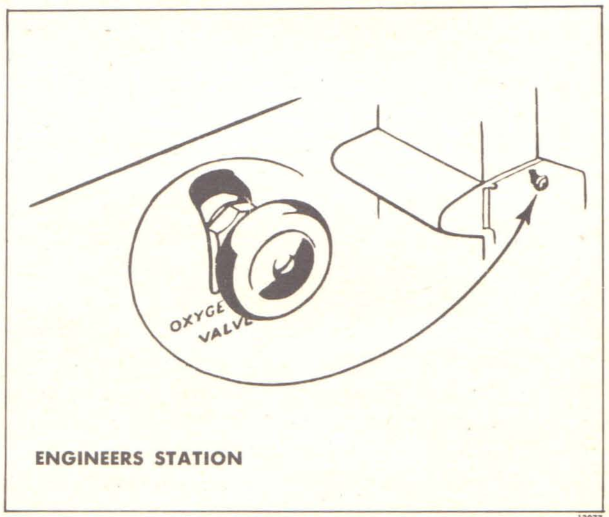


Figure 53 — Emergency Oxygen Valve

9. FIRE.

a. The B-29 is equipped with a CO_2 system fed by two high pressure CO_2 bottles mounted in the nose wheel well. Lines from each bottle run to all four engine nacelles. The flight engineer can direct the CO_2 charge to the desired engine by turning the selector knob on his instrument panel, and pulling the CO_2 release handle (or both handles, if desired) for the bottle he wishes to use.

b. Besides the nacelle extinguisher system, each airplane is equipped with three hand extinguishers, two CO_2 and one carbon tetrachloride, for extinguishing cabin fires. One CO_2 extinguisher is located on the inboard side of the flight engineer's control stand, the other is in the aft pressurized compartment, aft of the auxiliary equipment panel. The carbon tetrachloride extinguisher is located beside the rear entrance door.

(1) PRECAUTIONS IN USE OF FIRE FIGHTING EQUIPMENT.

(*a*) To use the carbon dioxide extinguisher, stand close to the fire, raise horn, and direct gas to the base of the fire, holding on to the rubber insulated tubing.

WARNING

Do not grasp metal horn on top of the cylinder. White discharge is "dry ice"; avoid frostbite.

(*b*) To stop flow of gas, replace horn in clip on side of cylinder. Recharge extinguisher after each use.

(*c*) Stand as far as possible from the fire when using the carbon tetrachloride extinguisher; effective range is 20 to 30 feet.

(*d*) To operate, turn handle and pump. Keep the stream full and steady. To shut off, push handle in and turn until sealing plunger is depressed.

WARNING

When sprayed on a fire, carbon tetrachloride produces phosgene, a very poisonous gas, which can be harmful even in small amounts. If inhaled in excessive amounts, it may be fatal. Do not use in confined areas and do not stand near the fire. Ventilate as soon as fire is extinguished.

(2) ENGINE FIRES.

(*a*) NACELLE OR ENGINE FIRE ON THE GROUND.—If the fire is known to be a torching turbo, put it out by increasing throttle setting momentarily. For other engine or nacelle fires on the ground, use the following steps:

1. Move mixture control to idle cut-off on all four engines.

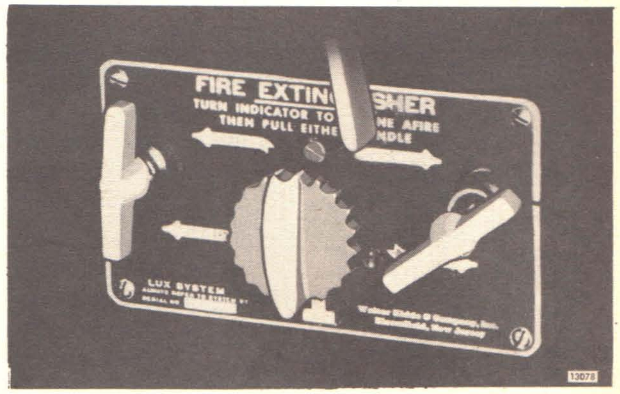


Figure 54 — Fire Extinguisher Selector Valve

2. Close fuel shut-off valves for all engines.

3. Turn "off" booster pump switches for all engines.

4. Close throttles.

5. Open cowl flaps.

6. Set nacelle fire extinguisher to proper engines. Pull first one, and then, if necessary, the other fire extinguisher control handle. Flight engineer will check with the scanners on condition of fire before pulling second control handle.

NOTE

The engine fire extinguisher is for fires in the accessory section and is not effective against fires in the engine itself. If fire is still burning:

7. Turn all ignition switches off.

8. Turn battery switch off.

9. Stop auxiliary power plant.

10. Send crew members for additional ground fire fighting equipment.

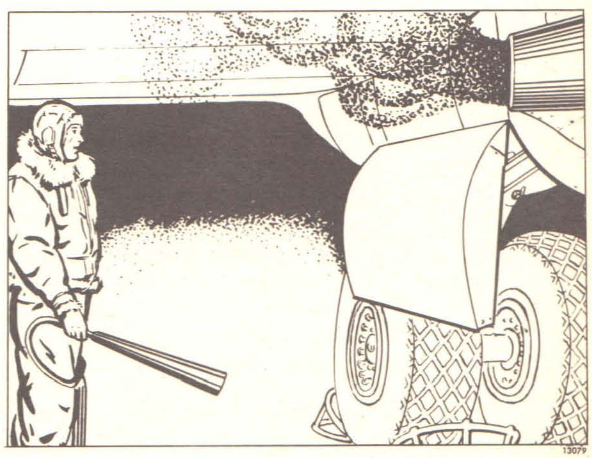


Figure 55 — Nacelle Fire

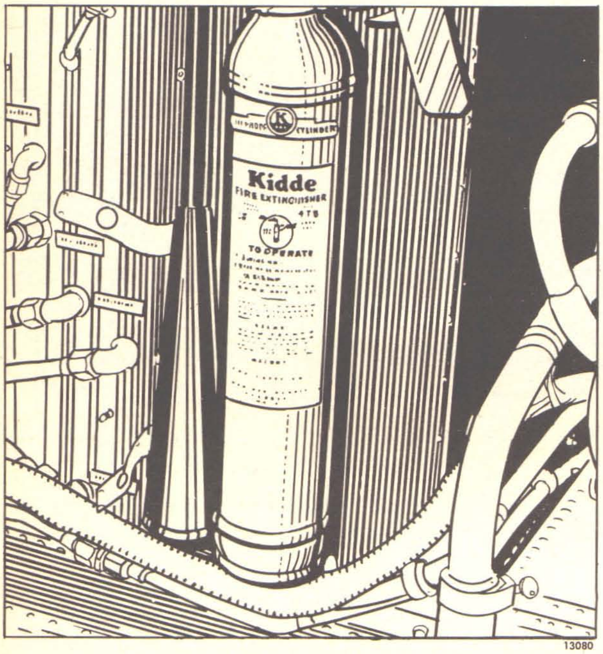


Figure 56 — Hand Type Fire Extinguisher

(3) NACELLE FIRE IN FLIGHT.

(*a*) Crew members spotting the fires "call" position on jackbox and says, "Fire on No. .... Engine". (If possible, crew member will identify fire as to type and location.) From this point, at the pilot's discretion, the following procedure should be used.

1. Pilot feathers propeller and says to flight engineer, "Use engine fire procedure".

2. Flight engineer moves mixture control for engine afire to "IDLE CUT-OFF", shuts fuel valve and boost pump "OFF" as pilot increases air speed in an attempt to blow out the fire.

3. Set cowl flaps to not more than 15 degrees and close throttle.

4. Set nacelle fire extinguisher to proper engine, pull first one, and then if necessary, the other fire extinguisher control handle.

5. Flight engineer closes cabin air valves and radio operator closes forward pressure door. If smoke has entered the cabin, copilot opens his window. In case of excessive smoke or fire in the cabin, follow procedure under "CABIN FIRES DURING FLIGHT".

6. If the fire is out of control, open bomb bay doors, and abandon airplane. (See bail out procedure.)

7. If engine catches fire during take-off, pilot will, if unable to put out the fire, make emergency landing, following the crash landing procedure if necessary.

(4) CABIN FIRES DURING FLIGHT.

(*a*) In all cabin fires during flight, IMMEDIATELY PULL THE EMERGENCY PRESSURE RELIEF HANDLE IF THE CABIN IS PRESSURIZED. If the fire is in the rear compartment, use the CO_2 extinguisher first, and then if necessary, use the portable carbon tetrachloride extinguisher. If the fire is in the forward compartment use the CO_2 extinguisher mounted beside the flight engineer's control stand.

(*b*) If the cabin fire is caused by an electrical short circuit, the procedure is the same, except that the flight engineer must turn all electrical power OFF with the battery and generator switches.

(*c*) If the cabin becomes excessively smoky or gaseous after using the fire extinguishers, open the bomb bay doors for ventilation. If the fire is extremely bad, and there is danger of an explosion from fuel tanks, sound a series of short rings on the alarm bell so the crew can prepare to abandon the airplane.

10. EMERGENCY EGRESS. (Figure 56)

a. EMERGENCY EXITS DURING FLIGHT.—Crew members in the forward compartment can bail out through the nose wheel well (landing gear down) or through the forward bomb bay. Those in the rear compartment may drop through the aft bomb bay or out through the rear entrance door. The tail gunner can bail out through the window at his side.

b. EMERGENCY EXITS AFTER DITCHING.—When the airplane is ditched on the water the pilot's, copilot's, and the engineer's removable windows can be used for exits. The airplane usually floats well, so all personnel do not need to exit simultaneously.

c. EMERGENCY EXITS AFTER CRASH LANDING.—Forward compartment: Pilot's, co-pilot's or engineer's removable windows. Rear compartments: Main entrance door on the right side or the rear escape hatch.

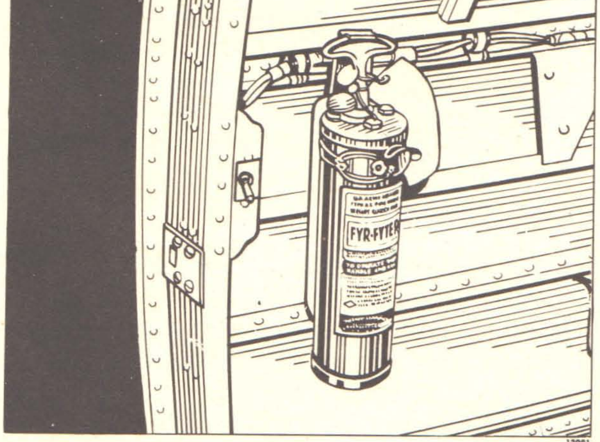


Figure 57 — Hand Type Fire Extinguisher

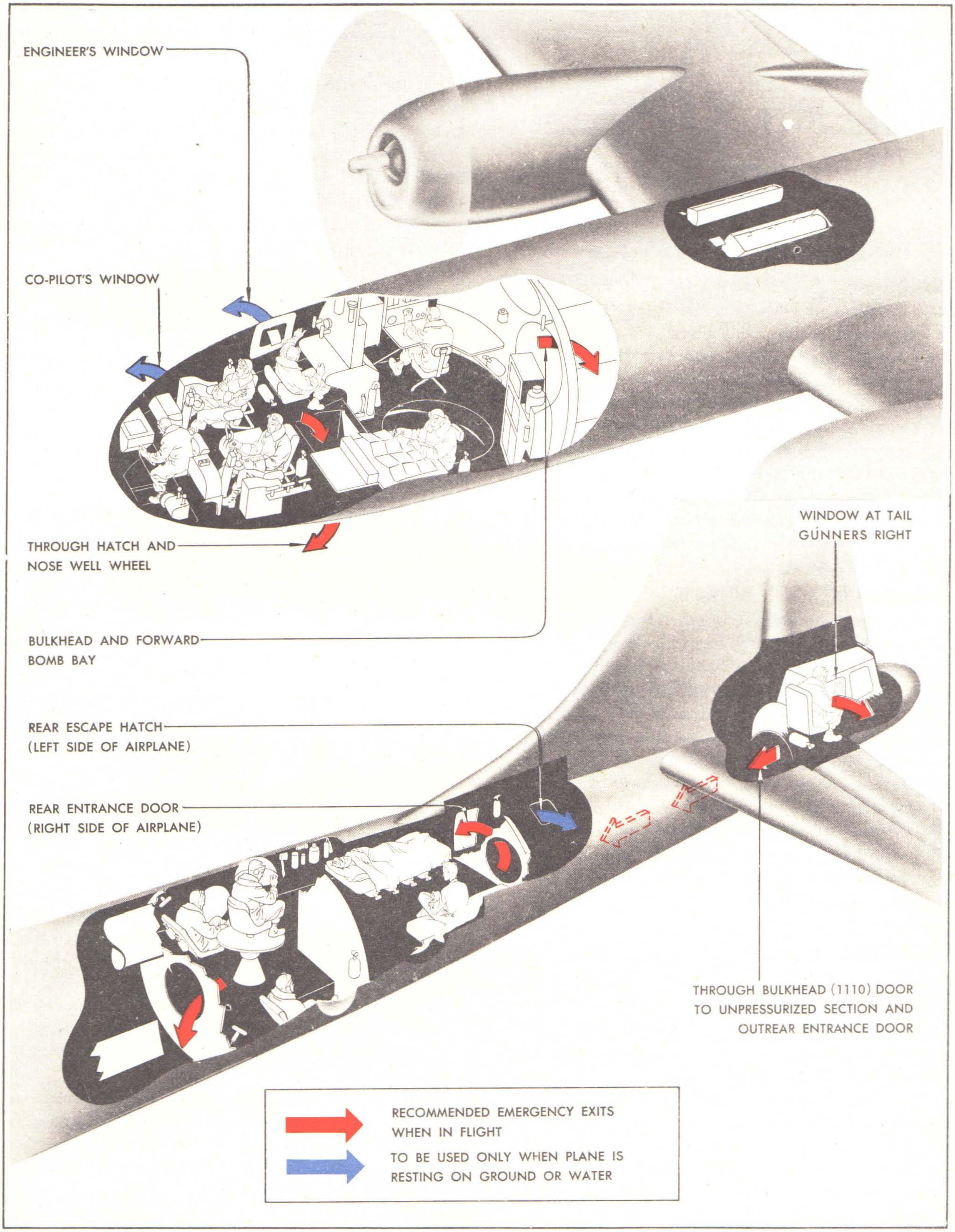


Figure 58 — Emergency Exits

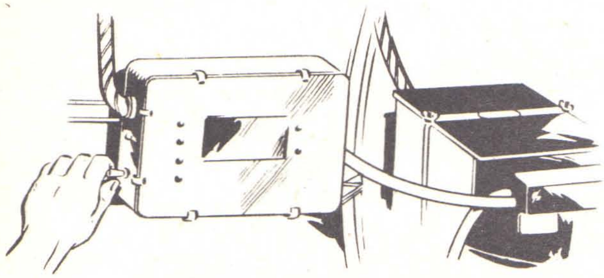


Figure 59—Bus Selector Switch (Early Airplanes)

11. EMERGENCY BOMB BAY DOOR OPERATION.

Install the portable electric motor (normally stowed in the center wing section) in the forward or aft bomb bay door socket (center of the right catwalk) and connect the plug in the outlet just above the socket. (On early airplanes, turn the transfer switch or the bus selector switch to "EMERGENCY." The put-put must be "on the line" when the bus selector switch is used.) Turn the portable motor switch to "UP" to open the bomb-bay doors, and to "DOWN" to close them. The motor has no limit switch. Operation beyond the full open or full closed position will burn out the motor. The bomb bay doors can not be handcranked.

12. EMERGENCY BOMB RELEASE.

For emergency mechanical bomb release, wind the bombardier's hand wheel 2½ turns clockwise, or pull the emergency release handle (one on the pilot's control stand, the other aft of the forward pressure bulkhead of the rear pressurized compartment.) The first part of the pull releases the doors, allowing them to open. The second part of the pull operates the bomb release levers, releasing the bombs unarmed. The total length of the pull is about 30 inches. The doors can be closed after emergency release by turning the bombardier's wheel 2½ turns counterclockwise and by extending the bomb retraction screw until it engages the door mechanism; the doors can then be raised in the usual manner.

13. EMERGENCY WING FLAP OPERATION.

a. Check the pilot's Power Transfer Switch and the Bus Selector Switch in "NORMAL" position.

(1) After the gear is lowered, have a crew member insert the emergency flap motor, and plug the cord in the receptacle. Place the three-way switch in "Flaps Down" position. The flaps will not lower, because the emergency system is not energized.

(2) The pilot can obtain flaps to any degree he desires through momentary use of his Power Transfer Switch in the "EMERGENCY" position. DO NOT USE OVER 40 DEGREES OF FLAPS AS THERE ARE NO LIMIT SWITCHES.

(3) To raise the flaps, have a crew member put the flap switch in the "Flaps Up" position, and use the "EMERGENCY" position of the Power Transfer Switch. In case of a refused landing the pilot can "work" the flaps up in this manner.

b. If the entire normal airplane power system is inoperative, leave the Power Transfer Switch in "NORMAL." Start the auxiliary power plant, and install the auxiliary flap motor. The flaps can be controlled as desired by having a crew member momentarily move the Bus Selector Switch from "NORMAL" to "EMERGENCY" upon instructions from the pilot through the interphone.

IN AIRPLANES WITH MANUAL EMERGENCY LANDING GEAR SYSTEM, THE PILOT'S POWER TRANSFER SWITCH AND THE BUS SELECTOR SWITCH ARE REMOVED. THE AUXILIARY FLAP MOTOR RECEPTACLE IS CONNECTED DIRECTLY TO THE NORMAL BUS. ALL OPERATION IS ACCOMPLISHED WITH THE AUXILIARY FLAP MOTOR SWITCH UPON INSTRUCTIONS FROM THE PILOT OVER THE INTERPHONE.

14. EMERGENCY LANDING GEAR OPERATION.

a. EARLY AIRPLANES.—Check to see that the fuse in the pilot's aisle stand is not burned out. If the fuse is in good condition, return the normal gear switch to "NEUTRAL." The landing gear transfer switch (pilot's control stand) or the bus selector switch (battery solenoid shield) should be turned to "EMERGENCY." These switches direct power to the emergency bus; the former from the engine driven generators, the latter from the "put-put" and battery. When the bus selector switch is used, the "put-put" should be "on the line."

(1) To open the main gear doors, pull the nacelle door and clutch handle out all the way and hold until the doors are open. The emergency switches for the main landing gear are on the forward wall of the forward bomb bay, one on each side of the door. Each main gear should be lowered separately. It's a good idea to hold an emergency switch down for 15 seconds after all apparent movement of the landing gear has stopped.

(2) The nose gear emergency switch is on the aft wall of the nose wheel well just below the floor.

(3) There is no emergency means of extending or retracting the tail skid.

(4) As a last resort, to lower the gear, return the landing gear transfer switch to "NORMAL" and turn the bus selector switch to "EMERGENCY." Then turn the normal gear switch to "DOWN," pull the emergency landing gear release handle out all the way, and turn emergency landing gear switches to "DOWN" position. When used, be sure normal and emergency switches are both "UP" or both "DOWN" to avoid working the motors against each other.

(5) If main gear doors fail to open by normal or emergency means, emergency motors can be used to drive the gear down and force the doors open.

(6) Emergency raising of gear is done in the same manner, but main gear doors can not be closed. Emergency motors are actuated by three separate emergency landing gear switches. Do not raise the gear by use of the emergency system if conditions are otherwise normal. Land and find out what's wrong.

(7) Do not practice emergency landing gear operation during flight. Practice emergency operation on the ground with the airplane on stands.

b. AIRPLANES WITH MANUAL EMERGENCY LANDING GEAR.

(1) GENERAL. — The emergency landing gear system can be operated either with power supplied from the auxiliary flap motor, or manually by hand cranks. Instruction decals are placed above each gear box for the main gears, and a decal is placed on the back of the copilot's armor plate for nose gear operation.

(2) DESCRIPTION. — EMERGENCY MAIN GEAR.—A gear box for each main gear is mounted on the wall, above the catwalk, just aft of the rear wing spar. The box on the right hand side actuates the right gear, and the box on the left side actuates the left gear. A nacelle door and clutch handle on each side of the airplane at bulkhead 485, serves to disconnect the normal electric motors, engages the manual system, and operates the emergency nacelle door release. A hand crank for each gear box is stowed in clips on the rear spar bulkhead of B-29A airplanes. On the B-29, the cranks are stowed just above the catwalk at station 520. The portable auxiliary flap motor may be used instead of hand cranking if desired.

(3) POWER OPERATION — EMERGENCY MAIN GEAR.

(a) Install the portable auxiliary flap motor at the lower position on the gear box. BE SURE THE NACELLE DOOR AND CLUTCH HANDLE IS OUT AND SECURED. The switch positions are noted on the motor handle.

(b) Run the motor until the stops engage. (A jar will occur and the motor clutch will start slipping.) One minute is required for retracting; 40 seconds for extending.

WARNING

ALWAYS RELEASE THE NACELLE DOOR AND CLUTCH HANDLE IMMEDIATELY AFTER MANUAL OPERATION IS COMPLETED.

(4) MANUAL OPERATION — EMERGENCY MAIN GEAR

(a) Pull the nacelle door and clutch handle.

(b) Allow the swaged ball on the cable to drop behind the slot in the bracket.

(c) To raise the gear manually, insert the crank into the upper socket of the gear box. Turn clockwise until the stops engage. About 30 minutes will be required to complete the 774 turns.

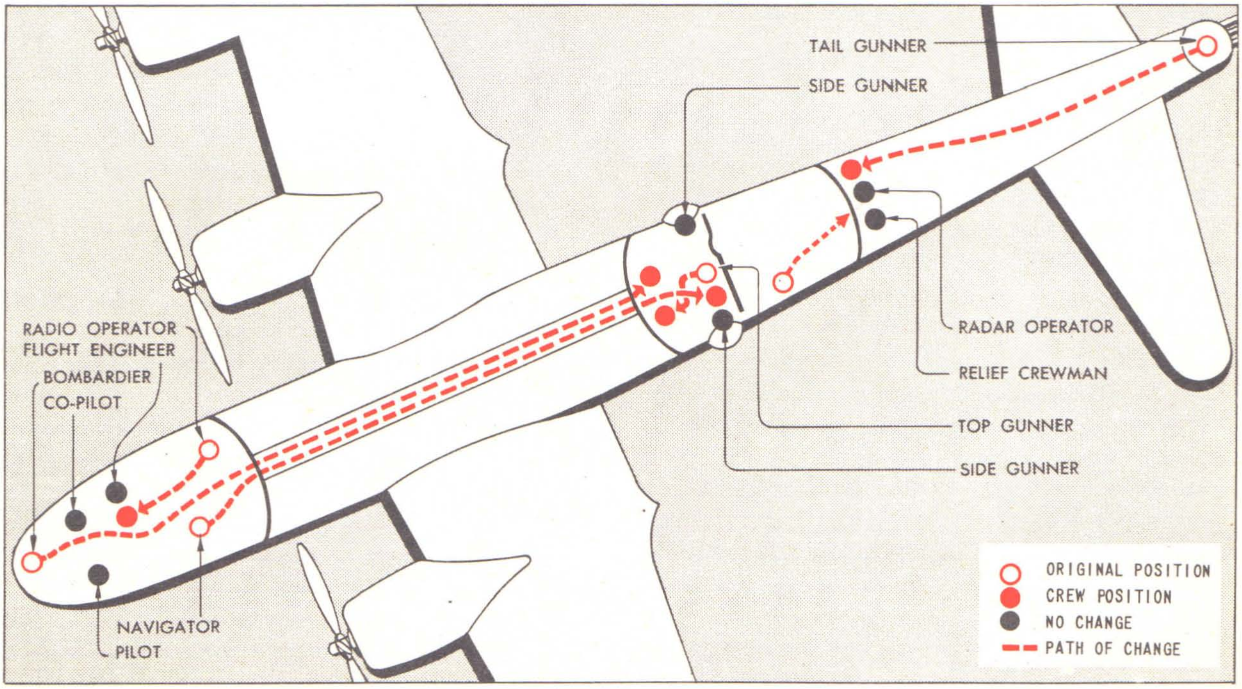


Figure 60 — Crash Landing Positions

(d) To lower the gear manually, insert the crank into the lower socket. Turn clockwise until the stops are engaged. 387 turns, taking about 12 minutes, are required.

(5) DESCRIPTION — EMERGENCY NOSE GEAR.—The gear box socket for manual operation is accessible through a plugged hole in the floor aft of the aisle stand.

A support beam for the crank handle is clamped to the copilot's armor plate stanchion.

The nose gear hand crank is stowed under the forward entrance hatch.

(6) OPERATION—EMERGENCY NOSE GEAR.

(a) Unscrew plug in the floor, using the hand crank as a wrench.

(b) Release upper end of support beam, swing down to horizontal position and secure to the pilot's armor plate stanchion.

(c) Insert shaft of crank through hole in beam, down through hole in floor and into socket.

Note

If crank will not turn, open entrance hatch and disengage the clutch by moving clutch lever to the right (facing forward). The spring on the lever handle will attach to a clip to hold it in position.

(d) The nose gear can be raised or lowered with 257 turns of the crank.

WARNING

ALWAYS RETURN THE CLUTCH HANDLE TO THE ENGAGED POSITION AFTER HANDCRANKING. ALSO REMOVE THE CRANK AND STOW THE BEAM.

15. EMERGENCY LANDING.

a. WHEELS UP.—When an approach is made for a crash landing with wheels up, drag is reduced considerable, so care must be taken to avoid overshooting the intended landing spot. Do not feather the propellers unless engine trouble requires feathering.

(1) If feasible, circle landing area until remaining fuel supply is 200 gallons for each engine.

(2) Clear traffic; call for crash trucks, if possible.

(3) Give crew members not essential to crash landing permission to bail out if altitude is sufficient. Remaining crew will take crash landing positions.

(4) Clear lower turret areas for crash landing; turrets may tear loose and be forced up into the cabin.

(5) Drop all bombs, auxiliary bomb bay tanks, flares.

(6) Open emergency escape hatches, except the bomb bay doors.

(7) Close the wheel well nacelle doors.

(8) Make normal approach sufficiently far from the field and high enough for the crew to perform the following last minute preparations at the pilot's command.

(9) See that flight engineer is prepared to set engine nacelle fire extinguisher selector to any engine that may catch fire after landing.

(10) Lower full flaps for landing.

(11) Stop auxiliary power plant.

(12) Shut boost pumps off.

(13) Close fuel shut-off valves (toggle switches on engineer's panel) on final approach when certain of making the field. (Approximately 10 to 15 seconds of fuel, at low power, remains in the lines after closing the fuel shut-off valves.)

(14) Just prior to contact with the ground, throttle back and move mixture controls in "IDLE CUT-OFF."

(15) Turn master switch and battery switch "OFF."

(16) Warn crew members just prior to ground contact, then make normal landing by sliding airplane in on its belly.

b. NOSE WHEEL IMPAIRED.—Following are the recommended steps to follow in making an emergency landing when both main gears are down and the nose wheel is up or partially up.

(1) Follow steps 1 through 14 as for belly landing, except for wheel doors (leave open), flaps (set 25 deg.), and load (shift disposable load to put C.G. back as far as possible), then proceed as follows.

(2) Hold the nose of the airplane in the air as long as possible with the elevators and then lower it gently until it strikes the runway.

(3) After the nose of the airplane strikes the runway, apply brakes as necessary to stop the airplane.

c. ONE MAIN WHEEL IMPAIRED. — When one main wheel is up, and the nose wheel and one main wheel are down.

(1) With wheels down, follow steps (1) through (14) for belly landing.

(2) Make normal landing on good wheel with wing tip low on the good wheel side.

(3) Hold the wing on bad wheel side up as long as possible with ailerons.

(4) Use brakes to minimize sharp ground loop when the bad side wing tip and nacelle dig into runway.

d. NOSE GEAR AND ONE MAIN GEAR IMPAIRED.—When one main wheel is down, and nose gear and one main wheel are up.

(1) Use the same procedure as with One Main Wheel Impaired, and hold the nose up with elevator and the bad side wing tip up with ailerons as long as possible.

e. BOTH MAIN GEARS IMPAIRED. — If both main gears are impaired, raise all wheels and make a belly landing.

f. LANDING ON SOFT RUNWAY.—If there is no hard surface to land on, raise all landing gears and make a belly landing.

16. EMERGENCY BRAKE OPERATION.

a. If the hydraulic pump fails in the air, and the rest of the airplane is functioning normally, one or both the normal and the emergency accumulators will be completely charged, giving approximately 2 or 4 available applications of either the normal foot brakes or the emergency hand brakes. Apply pressure steadily for reasonable time and refrain from pumping the brakes as the pressure in either accumulator decreases rapidly. Maximum use of the pressure available in the accumulators may be obtained by not releasing the brake pedals entirely, as complete release will then require again a maximum volume of fluid to fill the expander tube and a greater decrease in pressure.

b. If both accumulator pressures are down, and it is impossible to charge the emergency accumulator in the normal manner, then the hand pump may be used. It is necessary to fill the normal system accumulator before sufficient pressure will be available to operate brakes. This will require over 150 strokes of the hand pump. Check to determine, if possible, whether there are any broken lines, and if there is sufficient fluid in the tank, before attempting to charge the system with the hand pump.

c. If all efforts to charge the accumulators fail and hydraulic pressure is not available for the brakes for landing purposes, the following procedure is recommended:

(1) If a 7,000 to 10,000 foot runway is available, reduce gross weight to 85,000 to 90,000 pounds, if possible, and proceed as follows:

(a) Station crew in the rear in same positions as prescribed for crash landing.

(b) Place the Bus Selector Switch in the "Emergency" position.

(c) Upon contact with the ground, stop the two inboard engines.

(d) If the airplane can be slowed down to approximately 50 MPH, a turn off the runway may be attempted to keep the airplane within the flying field, until it has come to a complete stop.

(e) If this cannot be done, stop all engines, move the Nose Wheel Emergency Toggle Switch until only the nose wheel has collapsed. This will allow the airplane to skid to a stop on the main wheels and the nose of the airplane.

Note

IN AIRPLANES EQUIPPED WITH THE MANUAL EMERGENCY LANDING GEAR SYSTEM, STEPS (b) AND (e) DO NOT APPLY, AS THE EMERGENCY ELECTRICAL SYSTEM IS REMOVED.

17. DITCHING

Ditching the B-29 in its present configuration is a special problem, completely different from any other airplane. The large bomb bay doors and the extreme length of the fuselage have caused the following conditions in ditchings so far experienced by B-29 airplanes.

a. Bomb bay doors usually collapse unless modified to strengthen.

b. A wall of water breaks down the front door of the rear pressurized compartment.

c. The entire tail section fills with water and sometimes breaks off and sinks.

Modifications now in engineering will provide:

a. Reinforced bulkhead pressure door.

b. Reinforced bomb bay doors.

C- Escape hatch on top of rear pressurized compartment.

d. Ditching belts.

In spite of negative factors, successful ditchings have been accomplished on existing B-29 airplanes by moving all crew members to the front pressurized compartment. The front compartment is reasonably water-tight, does not collapse upon impact, and has been known to float for days after ditching.

a. DITCHING DRILL.—Successful ditching depends on constantly repeated drill. Reactions must be automatic. The procedure must be as orderly as possible. Equipment needed after the plane has been abandoned must not be left behind. The whole crew must practice together the coordinated steps of the ditching procedure just as often as possible. Wet ditching drill, the actual launching and boarding of life rafts in water, is preferable. If there are no facilities for wet ditching drill. practice the ditching procedure in your own plane under simulated conditions. Learn your job. Learn the job of every man in the crew so that nothing can be overlooked.

b. WIND DIRECTION. Study the appearance of the sea in relation to wind speed and direction. Try to become thoroughly familiar with surface conditions; they are an index to the wind. Waves move down-wind, but the foam of the crest appears to slide down the back, the windward, side of a breaking wave. Spray from wave crests is blown downwind. Swell is a rising and falling of the surface of the sea; swell does not indicate wind direction.

c. WIND SPEED.

(1) A few white crests	10-20 mph
(2) Many white crests	20-30 mph
(3) Streaks of foam along water	30-40 mph
(4) Spray from crests	40-50 mph

d. ALTITUDE.— Altitude is difficult to judge when the surface of the sea is smooth. Radio operator should lower trailing antenna until it strikes the water, and notify the pilot when current drops.

e. HANDLING THE AIRPLANE Ditch along the top of a steep swell. Ditch upwind in a long shallow swell. If there is a cross wind over 20 mph, ditch into the wind. If ditching into the wind involves ditching across a swell, put the airplane down on an upslope toward the top. After flattening out, try to keep the airplane from striking the water until all excess speed is lost. If the airplane alights tail down, there will be a jolt as the tail strikes, followed by a severe impact and violent deceleration. If you come in too fast on a calm sea, there will be a tendency to bounce; hold the control column back hard. In a sea with average size waves, the tail will touch the crest of the wave first. Keep the nose up so the forward part of the airplane will touch the next wave

crest approximately under the center of gravity The airplane "boats", but if the nose submerges, it will hold.

f. PREPARATIONS.— When an emergency develops making it doubtful you will reach land, start your preparations for ditching at once. Start with the preliminary radio procedure. Don't wait for the situation to improve. Experience indicates radio signals sent prior to ditching are the best aid to searchers. If you are able to make land, cancel the SOS, so that you won't waste the time of other crews and jeopardize their safety. Check the fuel supply; power is important in ditching; ditch before the fuel is exhausted. Keep a margin of speed available so you can pick your spot to set the airplane down.

g. CREW PROCEDURE. Check the procedure for each member of the crew against your airplane. Remember that crew members are not to take ditching stations in any rear compartment; they will be flooded if the bomb doors and the forward bulkhead of the rear pressurized com-

partment collapse. There is the possibility that you may be forced to ditch because of fire; remember, you can't swim underwater to avoid burning fuel on the surface if your life vest has been inflated.

(1) PILOT

(a) Give copilot warning: "PREPARE FOR DITCHING IN - MINUTES!" Give several short rings on alarm bell. Turn IFF Emergency Switch "ON". Remove parachute harness, flak suit, and winter flying boots. Keep flak helmet on. Fasten safety belt.

(b) Advise any accompanying aircraft of distress by radio, then turn to interphone.

(c) Give copilot order: "OPEN EMERGENCY EXITS AND THROW OUT EQUIPMENT". If possible give this order above 5000 feet.

(d) Give copilot order: "STATIONS FOR DITCHING; IMPACT IN - SECONDS." If possible give this order above 2000 feet. Order flight engineer to "STOP INBOARD ENGINES". Feather inboard propellers. Simultaneously push both radio destruction buttons . Open windows. brace feet on rudder pedals, knees flexed. About 5 seconds before impact, give copilot order: "BRACE FOR IMPACT".

(e) Exit through left window. If plane is not afire, inflate life vest when on window ledge. Climb atop cabin, thence to left wing.

(2) COPILOT

(a) Relay pilot's command over interphone call position: "PREPARE FOR DITCHING - MINUTES Receive acknowledgments. Tell the pilot: "CREW NOTIFIED".

(b) Remove parachute harness, flak suit

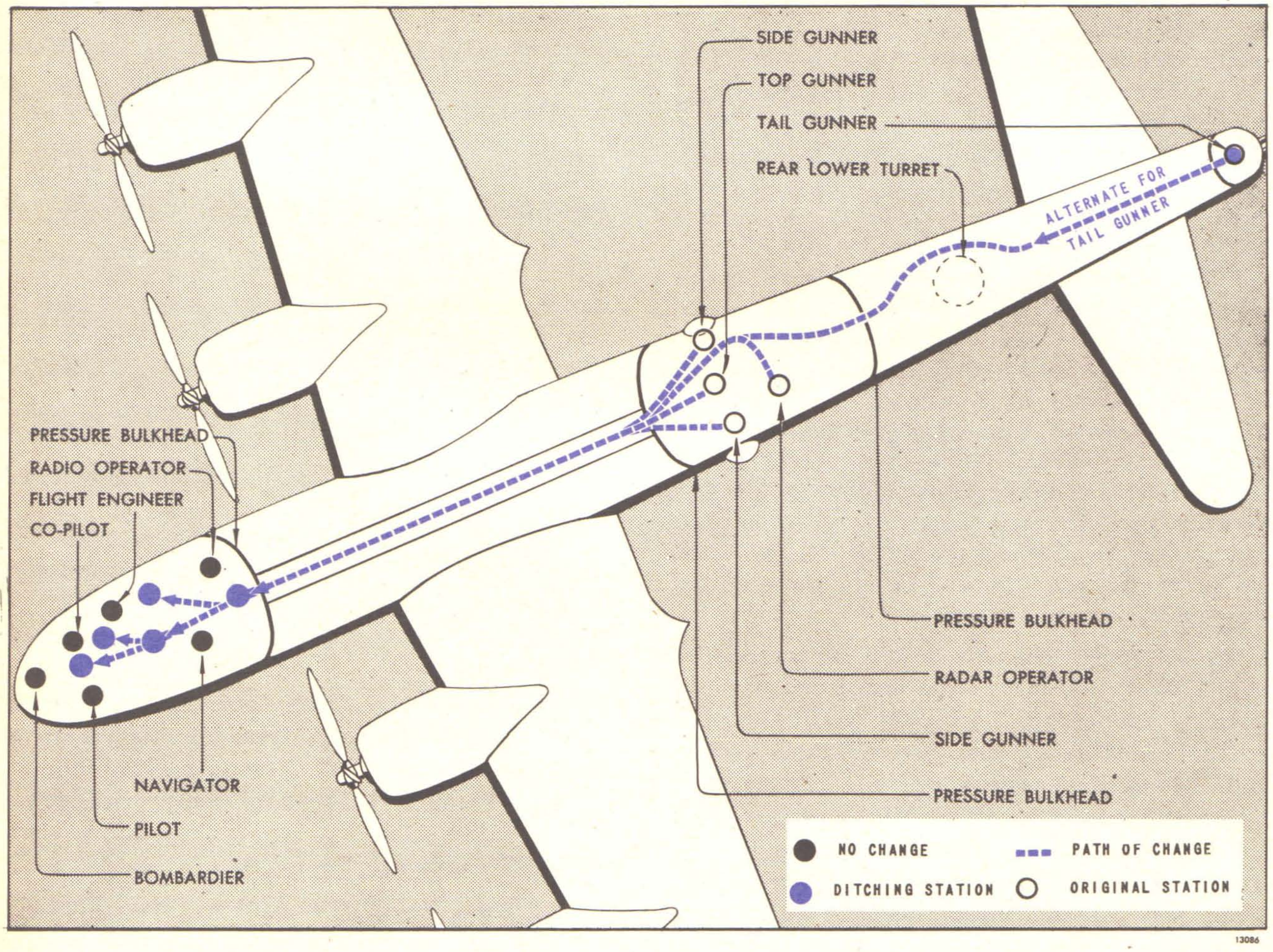


Figure 61 — Stations for Ditching

and winter flying boots. Keep flak helmet on. Fasten safety belt.

(c) Stand by on interphone to relay pilot's orders.

(a) Relay orders: "OPEN EMERGENCY EXITS AND THROW OUT EQUIPMENT" and check on crew's progress.

(e) Relay order: "STATIONS FOR DITCHING. IMPACT IN - SECONDS". Open side window, brace feet on rudder bar with knees flexed. When pilot gives order: "BRACE FOR IMPACT", send one long ring on alarm bell.

(f) Exit through right window. Inflate life vest on window ledge. Climb atop cabin, thence to right wing. Secure right life raft or pull outside raft release handle if necessary.

(3) BOMBARDIER

(a) Acknowledge in turn: "BOMBARDIER DITCHING".

(b) Remove parachute harness, winter flying boots, and flak suit. Keep flak helmet on.

(c) Jettison destroyed bombsight and data.

(d) Open bomb bay doors, jettison bombs, ascertain that other crew members have finished jettisoning all loose equipment and then close and check bomb bay doors. Shoot out ammunition from front turrets.

(e) Place extra life rafts near engineer's escape hatch.

(f) Sit in bombardier's seat; fasten safety belt, and rest pillow-protected head on arms crossed on knees. Brace feet on structure at base of window.

(g) Tie life raft line to your arm, throw out the raft, and exit through left window.

(4) FLIGHT ENGINEER

(a) Acknowledge in turn: "FLIGHT ENGINEER DITCHING".

(b) Remove parachute harness, flak suit, and winter flying boots, Keep flak helmet on.

(c) Open front emergency hatch and acknowledge to copilot: "FRONT HATCH OPEN". Jettison it together with any other loose equipment through front bomb bay.

(d) Get the emergency signal kit and tie its line to your arm.

(e) Stop inboard engines on pilots command. Take regular position facing aft and keeping to your left, head and shoulders braced against copilot's armor plate, safety belt fastened, hands braced against control stand.

(f) Carrying signal kit, exit immediately through front emergency exit.

(g) If airplane is not afire, inflate life vest on window ledge. Climb atop cabin and proceed to right wing.

(h) Assist bombardier and copilot in securing life rafts.

(5) NAVIGATOR

(a) Acknowledge in turn: "NAVIGATOR DITCHING".

(b) Remove parachute harness, winter flying boots, and flak suit. Keep flak helmet on.

(c) Calculate position, course, altitude, and ground speed for radio operator to transmit.

(d) Give pilot surface wind strength and direction. Destroy classified documents.

(e) Gather maps and navigation equipment into water proof bag or tuck inside clothing.

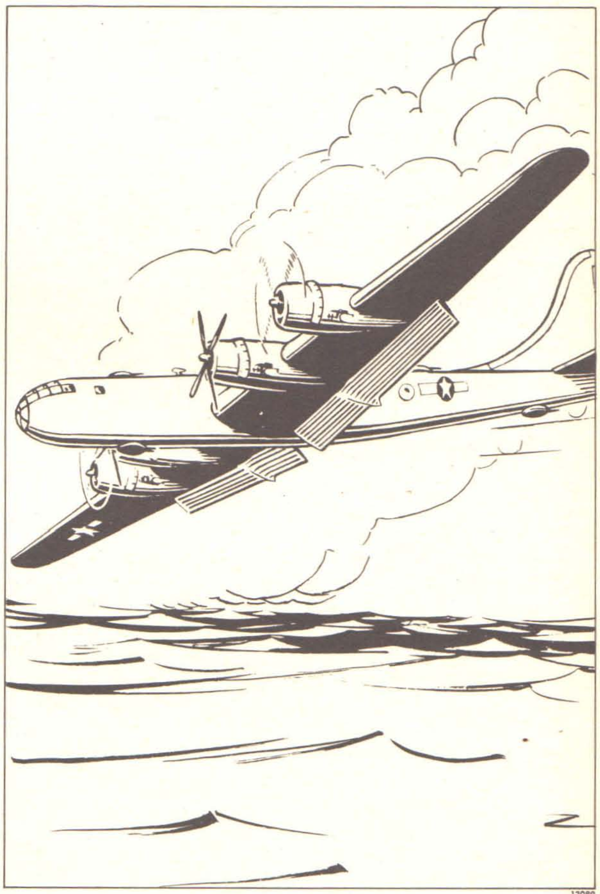


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Figure 62—Airplane Ditching

(f) Jettison all drift signal flares through release tube. Assist in jettisoning all loose equipment from front compartment, then close pressure door to bomb bay.

(g) Return to original position in navigator's seat, fasten safety belt. Slide seat full forward. Face forward with legs braced. Rest head on arms on table. Exit through engineer's emergency hatch.

(h) If airplane is not afire, inflate life vest. Proceed to right wing with navigation equipment.

(6) RADIO OPERATOR

(a) Acknowledge in turn: "RADIO OPERATOR DITCHING".

(b) Remove parachute harness, flak suit, and winter flying boots. Keep flak helmet on.

(c) Set IFF emergency switch ON. Put out trailing antennae. Transmit position, course, altitude and ground speed data as received from navigator on MF/DF. Relay fix or bearings obtained to navigator.

(d) Give MF/DF all data without waiting too long for answer.

(e) Destroy classified material; check IFF setting.

(f) Continue to send emergency signals. On command from copilot, clamp down transmitter key.

(g) Remain at radio operator's seat with safety belt fastened.

(h) After ditching, pull both life raft release handles at tunnel entrance.

(i) Pick up emergency radio and exit through engineer's emergency hatch.

(j) If airplane is not afire, inflate life vest on window ledge. Climb atop cabin and proceed to left wing.

(7) RADAR OPERATOR (OPTIONAL GUNNER)

(a) Acknowledge in turn: "RADAR OPERATOR (OPTIONAL GUNNER) DITCHING".

(b) Remove parachute harness, flak suit, and winter flying boots. Keep flak helmet on.

(c) Proceed forward through tunnel to front pressurized compartment.

(d) Take sitting position on floor with back against copilot's armorback. Squeeze in with the flight engineer and brace right foot across the aisle. Protect head with arms or pillows.

(e) Tie raft accessory kit line to your arm. Throw out raft accessory kit and exit through engineer's emergency hatch.

(8) TOP GUNNER.

(a) Acknowledge in turn: "TOP GUNNER DITCHING".

(b) Remove parachute harness, flak suit, and winter flying boots. Keep flak helmet on.

(c) Shoot out ammunition from rear upper turret. Check with other gunners to be sure all ammunition has been shot away.

(d) Close pressure door to bomb bay and reinforce if possible; proceed forward through tunnel to front pressurized compartment.

(e) Tie extra life raft line, if available, to your arm.

(f) Take sitting position on floor with back up against rear of engineer's panel. Use cushions behind back, and brace feet.

(g) Throw out life raft; exit through copilot's side window.

(h) If plane is not afire, inflate life vest. Proceed atop fuselage to right wing.

(9) RIGHT GUNNER

(a) Acknowledge in turn: "RIGHT GUNNER DITCHING".

(b) Remove parachute harness, flak suit, and winter flying boots. Keep flak helmet on.

(c) Shoot out all ammunition in rear lower turret.

(d) Help jettison all loose equipment.

(e) Proceed forward through tunnel to front pressurized compartment. Sit between aisle stand and copilot's seat (width of hips may necessitate switching places). Flex knees and brace feet against rudder pedal supports, being careful not to touch or obstruct rudder pedals during approach. Protect head with arms or cushions.

(f) Exit through co-pilot's side window. If plane is not afire, inflate life vest, climb atop cabin, proceed atop fuselage to top wing. Secure left raft. If necessary, pull outside release handle.

(10) LEFT GUNNER

(a) Acknowledge in turn: "LEFT GUNNER ditching".

(b) Remove parachute harness, flak suit, and winter flying boots. Keep flak helmet on.

(c) Report secret equipment destroyed. Report members going forward through tunnel to ditching station.

(d) Be sure pressure door to bomb bay is closed and reinforced (if possible). Proceed forward through tunnel to front pressurized compartment. Secure line of raft accessory kit to arm.

(e) Lie down crosswise on floor, cushion and back against whell well step; bend at hips to extend legs back alongside of turret well. Protect head with cushion.

(f) If airplane is not afire, inflate life vest, climb atop cabin, and proceed to left wing.

(11) TAIL GUNNER

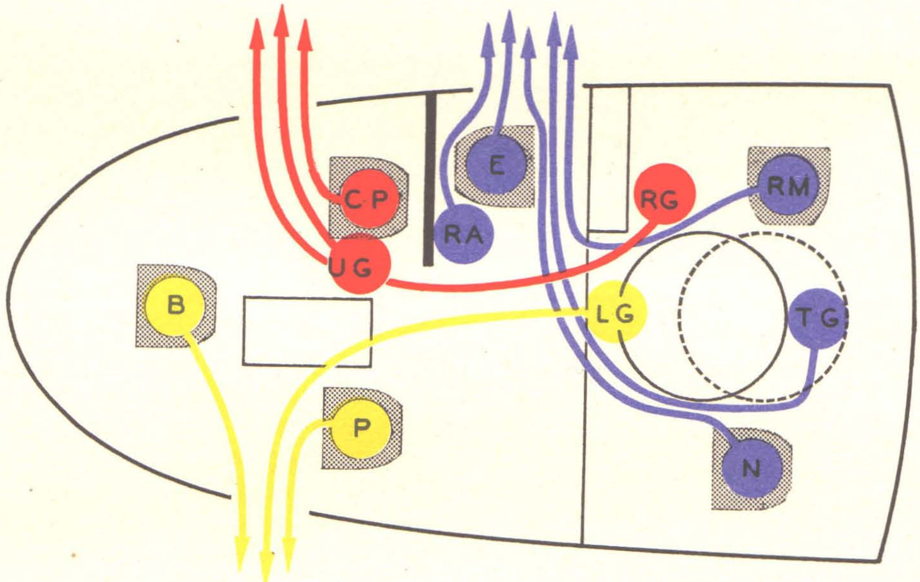
(a) Acknowledge in turn: "TAIL GUNNER DITCHING".

(b) Remove parachute harness flak suit, and winter flying boots. Keep flak helmet on.

(c) Shoot out ammunition in tail guns.

(d) Under most conditions, it is desirable to ditch in the tail gunner's compartment. Jettison escape hatch; remain in seat, safety belt fastened, back and head cushioned, knees flexed. When airplane comes to rest, tail may be low in water or under water. Dive out escape hatch and make way forward to left wing.

(e) As an alternate, proceed forward, being sure to close rear pressure door of relief compartment; continue forward through tunnel to front pressurized compartment. Lie down in tube on back, feet projecting out and braced against top of upper turret well, knees flexed. Brace hands against roof of tunnel.



IN SEATS

B	BOMBARDIER	UG	UPPER GUNNER
P	PILOT	LG	LOWER GUNNER
CP	CO-PILOT	RG	RIGHT GUNNER
E	ENGINEER	TG	TAIL GUNNER
RM	RADIO MAN	RA	RADAR OPERATOR
N	NAVIGATOR		

Figure 63 — DITCHING EXIT

(12)

Keep in mind that the positions detailed herein are for B-29's as of September 1944. Modifications to the airplane will permit changes in procedures and positions; revisions will be issued to detail these changes.

(a) Practice taking these positions quickly.

(b) See that your back and head are supported so you will not bounce around when the airplane hits.

(c) Remember that there is almost always more than one impact. Be sure the airplane has come to rest before leaving the ditching position.

NOTE

Some airplanes are equipped with astrodomes, this opening is a fine ditching exit.

h. DITCHING EQUIPMENT.

(1) DRIFT SIGNALS.- Twelve drift signals are stowed under the navigator's table. The drift signal chute is set on the floor just behind the navigator.

(2) HAND AXES.—There is a hand axe at the navigator's station near the fire extinguisher. There is another on the aft compartment auxiliary panel.

(3) LIFE RAFT.— There are two 6-man life rafts in the raft compartments atop the fuselage; the release handles for these rafts are at the forward entrance to the tunnel. A pull on the handles automatically releases the rafts and inflates them. There are external release levers on top the fuselage next to the compartment doors. Extra rafts are usually carried on the front pressurized compartment. These rafts are inflated by pulling a ripcord on the CO2 cylinders. Don't jump from the plane into a raft; you'll go right through. If a raft inflates inverted, don't jump on it to right it. You'll only push out the air underneath and make it harder to turn the raft over. Two or three men can right a raft, if they are standing on the wing; or, one man in the water can right a raft, if he throws the raftline over the far side, and pulls hand over hand. Send the rafts off the leading edge of the wing; wing flaps are usually torn loose in ditching and offer jagged edges which can easily puncture a raft. When all men are aboard, tie the rafts together.

(4) RAFT ACCESSORY KITS. There is an accessory kit for each raft. Ordinarily the kit is stowed inside the raft, but sometimes stowage problems make it necessary to stow the kit separately. If the kits in your plane are not in the rafts, be sure to assign the kits to crew members. When you're adrift, keep the items of your kit inside the raft; tie the kit to the bottom of the raft. Keep signaling equipment handy; when the time comes to use it, you'll want it in a hurry.

(5) EMERGENCY RADIO. The emergency radio is in two cases strapped together. There's a set of instructions in the kit. Get the emergency radio into operation as soon as possible. Keep the antenna out of the water if you want your signals heard. The three minute international silence periods, 15 and 45 minutes after the hour, are best for sending distress signals.

18 FIRST-AID KITS.

Five first-aid kits are supplied in the airplane, one each at the following locations: Engineer's auxiliary equipment panel, side wall of the engineer's stand, the back of the right-hand side gunner's seat, rear compartment auxiliary panel, and the tail gunner's compartment.

19. FLASHLIGHTS.

Each pressurized compartment is provided with a flashlight, located on the engineer's auxiliary panel and the rear compartment auxiliary panel, respectively.

20. PARACHUTES.

The pilot's, copilot's, engineer's, and navigator's seats accommodate seat or back-type parachutes. It will be necessary for other members of the crew to store their attachable parachutes so they will be readily accessible.

Note

Figures 64 through 67 omitted to make room for new temporary ditching procedure.

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SECTION V
OPERATIONAL EQUIPMENT

1. CABIN SUPERCHARGING AND HEATING.

a. GENERAL.—Cabin air for pressurizing and heating is taken from the duct leading from the inboard turbo superchargers of the inboard engines to the carburetor. The air then goes through the after cooler, which acts as a radiator to dissipate the excess heat generated by the turbo supercharger. The air then passes through this cabin air valve into the distribution ducts in the tunnel. If no turbo is being used, hot air passes over the after cooler drawn from the exhaust shroud. The controls are located to the left of the engineer. Adjustable thermostats are located on the engineer's auxiliary instrument panel. To prevent very large losses of supercharger air into the cabin duct (which would leave the engine unsupercharged) a restriction is located in the duct near the nacelle. A safety fire valve at the nacelle automatically closes if the cabin air temperature raises sufficiently to melt its lead-alloy fuse.

b. To get any air flow into the cabin, the pressure of the tubo air must be greater than that in the cabin. This requires a certain minimum turbo speed which means a minimum engine power on the inboard engines. To keep the drain on the turbo small, the cabin air-flow should be kept low.

c. When cruising with low gross weight the power of the engine may not be sufficient to keep up the cabin pressure at low flow. The RPM of the inboard engines may be increased about 200 RPM above that of the outboard engines to furnish enough boost for cabin pressure. For best range do not synchronize outboard engines with inboard engines. The cruising airspeed should be kept at that recommended for long range; if this is done there will be no loss in range, provided not more than 2100 RPM and 31 inches Hg. are held with the mixture control for the inboard engines in "AUTO LEAN".

d. The following is a check list for getting heat and pressure in the cabin when it is needed.

(1) TO OPERATE WITHOUT CABIN PRESSURE.

(a) GROUND RUNNING, TAKE-OFF AND DESCENT.

1. Open at least one pressure door.

2. Turn cabin temperature control on automatic.

(b) FLYING IN HOT WEATHER

1. Open all pressure doors.

2. Turn cabin temperature control on automatic.

(c) FLYING IN COLD WEATHER

1. Open only rear door in rear compartment, close all others.

2. Turn cabin air valves on.

3. Turn cabin temperature control on.

(2) TO OPERATE WITH CABIN PRESSURE

(a) GENERAL PROCEDURE

1. Close all pressure doors.

2. Turn cabin air valves on.

3. Turn cabin temperature control on automatic.

4. Close pressure relief valve.

5. Unlock cabin pressure regulators.

6. Retard throttles on No. 2 and No. 3 engines to hold desired manifold pressure.

7. When changing from unsupercharged to supercharged cabin above 8,000 feet altitude, the rapid change in cabin pressure may be uncomfortable. Retard throttles on No. 2 and No. 3 engines until descent on cabin climb indicator is less than 2000 feet per minute.

(b) FLYING AT MEDIUM AND HIGH POWER.

1. Set manifold pressure and RPM according to cruising charts (See Appendix II).

(c) FLYING AT LOW POWER FOR RANGE AND ENDURANCE.

1. When power requirements are below 2200 RPM and 35 inches Hg., adjust turbo boost selector to position 7; do not adjust knob setting further. Reduce engine power not lower than 2100 RPM and 31 inches Hg. above 20,000 feet, 2000 RPM and 28 inches

Hg. below 20,000 feet by throttling and changing RPM. Part throttle will have no serious effect on airplane range with engines operating at MP and RPM for best range. Alternate method: reduce power as required on all engines until "LOW FLOW" is reached on the cabin flow gages. This is the lower power limit of the inboard engines.

2. As power requirements become less, decrease outboard engine RPM in small increments with " PROPELLER " control maintaining 28 inches Hg. with throttle until full throttle is obtained. To further decrease power use the same procedure on inboard engines. Transfer necessary additional fuel to inboard engines.

3. Outboard engines should be operated at reduced power and RPM to cruise at best airspeed. Do not try to synchronize the inboard and outboard engines. Under these conditions no loss in range will result, provided no more than 2100 RPM and 31 inches Hg. in auto-lean is used on the inboard engines. Operating with all engines at equal power under the above conditions will result in an airspeed higher than the best for range.

(d) FLYING AT MAXIMUM ALTITUDE—ABOVE 33,000 FEET.

1. Close cabin air valve to obtain low flow on gages.

(e) DESCENDING.

1. Keep enough power on either inboard engine to obtain low flow on cabin flow gage.

(3) TESTING CABIN FOR LEAKAGE.

(a) Fly the airplane above 20,000 feet.

(b) Turn cabin flow control to No. 2 engine "OFF" and to No. 3 engine "ON".

(c) Turn minimum flow control to "LOW FLOW".

(d) Turn cabin air control for No. 2 engine "OFF", and the control for No. 3 engine to obtain "LOW FLOW" on the cabin flow gages.

(e) The cabin rate of climb indicator should stay at 0, and the cabin altimeter should remain steady after stabilizing altitude.

(f) If cabin leakage prevents retention of a steady pressure, open the cabin air valve on No. 3 engine and set the minimum flow control to obtain sufficient flow to maintain a steady cabin pressure.

(g) Check for leaks—see the diagram in the cabin.

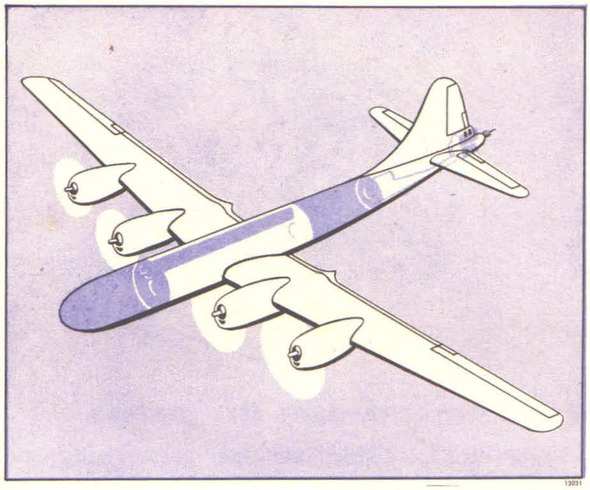

Figure 68 — Cabin Pressure (30,000 feet)

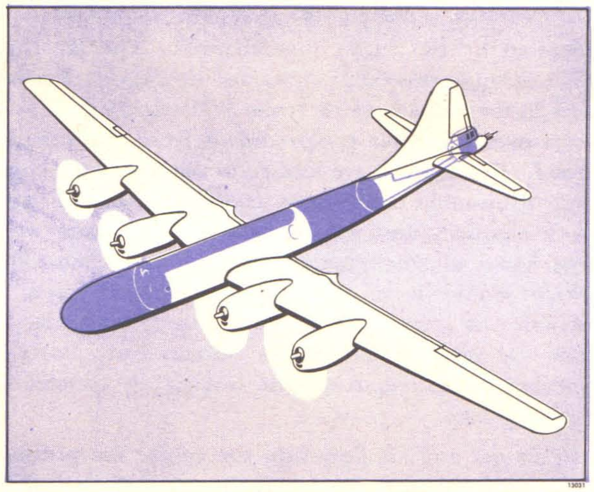

Figure 69 — Cabin Pressure (8,000 feet)

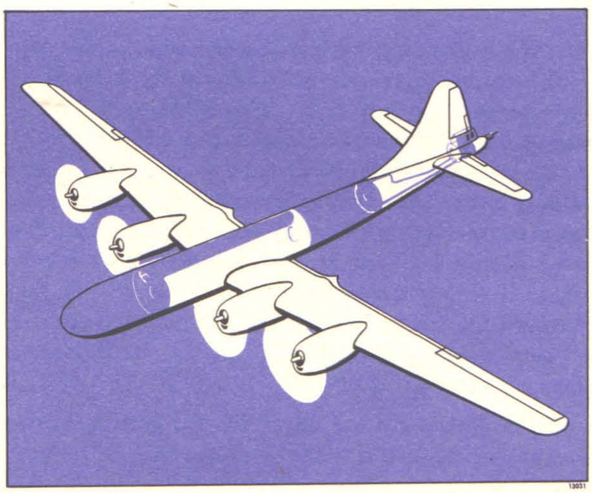

Figure 70 — Cabin Pressure (Sea Level)

e. DEPRESSURIZING PROCEDURE.—The cabin may be depressurized by closing the engineer's cabin air valves and opening the cabin pressure relief valve, if necessary. In emergencies, the cabin can be quickly depressurized by pulling either of two emergency cabin pressure release handles (Pilot's control stand, and left sidewall of rear pressure compartment near forward bulkhead.

WARNING

Always depressurize when expecting enemy action, when the airplane is on fire or when preparing to abandon the airplane.

2. OXYGEN SYSTEM.

a. SUPPLY SYSTEM.—The Demand Oxygen System is supplied by eighteen, type G-1, low-pressure shatterproof oxygen cylinders. The entire system is filled from one filler valve, located on the outside of the fuselage just forward of the wing on the left side.

Each of the 13 oxygen stations is supplied from two distinct distribution lines. Loss of one line or its associated cylinders still leaves each station with an alternate source of oxygen. The entire system is equalized by the use of crossfeeds controlled by automatic check valves. In the event of partial destruction of the system, all stations still functioning have equal access to the remaining oxygen supply.

b. REGULATOR PANELS.—Regulator panels are provided at the 12 crew stations throughout the airplane, and one additional panel is in place for an extra relief crew member. The equipment mounted on each regulator panel consists of an A-12 demand-type regulator, a K-1 oxygen pressure gage, a warning light, and a type A-3 flow indicator. The panels are within easy reach when the crew members are at their stations. The panel for the upper rear sighting station is mounted on the back of the swivel seat, and the oxygen line is brought up through the center post of the seat assembly and attached to the regulator panel through a swivel joint.

AIRCO REGULATORS
TYPE A-12

ALT. FT.	GAGE PRESSURE 400	350	300	250	200	150	100	50
40,000	11.3 11.3	10.7 10.7	8.8 8.8	7.1 7.1	5.3 5.3	3.6 3.6	1.7 1.7	E
35,000	8.8 8.8	7.5 7.6	6.3 6.3	5.0 5.0	3.8 3.7	2.5 2.5	1.2 1.2	M
30,000	6.4 6.4	5.5 5.6	4.5 4.7	3.6 3.7	2.7 2.8	1.8 1.8	.9 .9	E
25,000	4.9 6.3	4.1 5.4	3.4 4.4	2.7 3.6	2.1 2.7	1.2 1.8	.6 1.2	R
20,000	3.9 7.0	3.3 6.0	2.7 4.9	2.2 4.0	1.6 3.0	1.1 2.0	.5 .9	G
15,000	3.0 8.5	2.5 7.3	2.1 6.0	1.7 4.8	1.2 3.7	.9 2.4	.4 1.2	E
10,000	2.4 14.5	2.0 12.5	1.7 10.3	1.3 8.3	1.0 6.2	.6 4.1	.3 2.0	N
5,000	1.9	1.6	1.3	1.1	.8	.5	.3	C
S.L.	1.6	1.4	1.2	.9	.6	.4	.2	Y

PIONEER REGULATORS
TYPE A-12

ALT. FT.	GAGE PRESSURE 400	350	300	250	200	150	100	50
40,000	11.3 11.3	10.7 10.7	8.8 8.8	7.1 7.1	5.3 5.3	3.6 3.6	1.7 1.7	E
35,000	8.8 9.0	7.5 7.7	6.3 7.1	5.0 5.1	3.8 3.8	2.5 2.6	1.2 1.2	M
30,000	6.4 6.7	5.5 5.8	4.5 4.8	3.6 3.8	2.7 2.9	1.5 1.9	.9 .9	E
25,000	4.9 6.6	4.1 5.5	3.4 4.7	2.7 3.7	2.1 2.8	1.4 2.6	.6 .9	R
20,000	3.9 11.7	3.3 10.0	2.7 8.2	2.2 6.6	1.6 5.0	1.1 3.8	.5 1.8	G
15,000	3.0 11.4	2.5 9.7	2.1 8.1	1.7 6.5	1.2 4.8	.9 3.3	.4 1.5	E
10,000	2.4 11.6	2.0 9.7	1.7 8.0	1.3 6.4	1.0 4.8	.6 3.7	.3 1.5	N
5,000	1.9 8.5	1.6 7.3	1.3 6.0	1.1 4.8	.8 3.6	.5 3.2	.3 1.1	C
S.L.	1.6 9.0	1.4 7.7	1.2 6.3	.9 5.1	.6 3.8	.4 2.6	.2 1.2	Y

PROPORTION - 12 MEN; 18G-1 BOTTLES

BLACK FIGURES INDICATE AUTO MIX "ON"

RED FIGURES INDICATE AUTO-MIX "OFF"

CAUTION

THE AUTO-MIX IN THE "OFF" POSITION RAPIDLY DIMINISHES THE AVAILABLE OXYGEN SUPPLY.
DO NOT USE THIS POSITION UNLESS IT IS NECESSARY TO GET PURE OXYGEN!

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Figure 71 — Hours of Available Oxygen

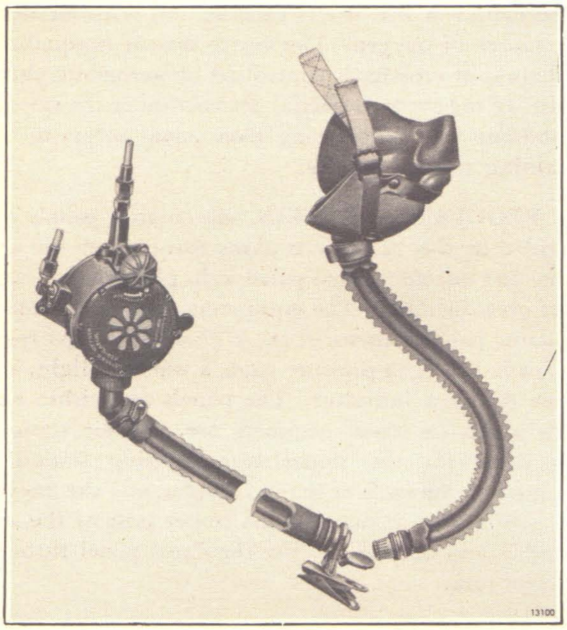


Figure 72 — Mask and Regulator

Each crew member has an oxygen mask and an A-12 demand regulator is placed at each crew station. The portable bottles also have regulators.

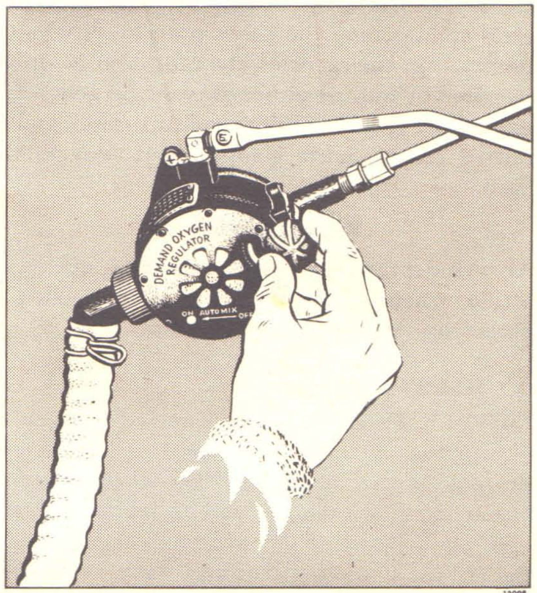


Figure 74 — Regulator

When in "AUTO MIX" the A-12 demand regulator supplies the proper mixture of air and oxygen. Altitude determines the percentage of oxygen.

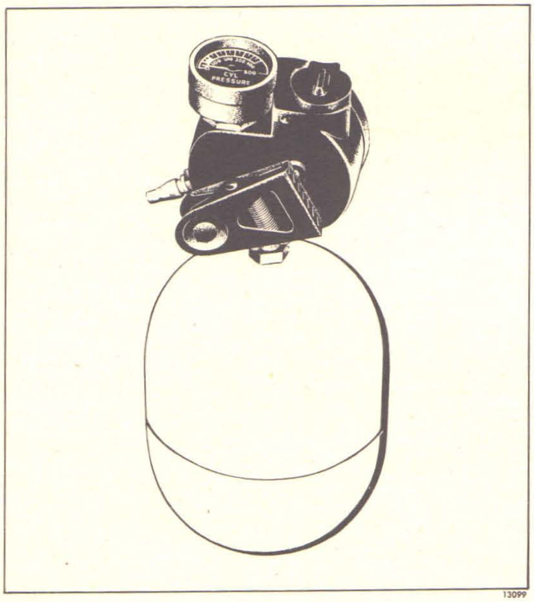


Figure 73 — Portable Oxygen Bottle

The portable oxygen bottles each have a mask hose coupling, a recharge valve, and an A-13 demand regulator with attached suspension clamp.

c. PRESSURE WARNING SWITCHES.—Pressure warning switches are located in the navigator's oxygen panel, radio operator's oxygen panel, and the panels at the right and left sighting stations. Each warning switch is located in a separate system and will operate warning lights only for the system in which it is installed. The switches are set to close the circuit and operate the warning lights at 100 pounds per square inch.

d. PORTABLE OXYGEN CYLINDERS.—At each crew station there is a portable oxygen cylinder with a regulator and a recharging hose. These cylinders may be used by the crew while moving about the airplane when it is necessary to use oxygen and may be recharged from the main system as required. The cylinder contains sufficient oxygen to last from 5 to 8 minutes, depending upon the activity of the individual and the system pressure for recharging.

e. CHECKING OXYGEN EQUIPMENT.

(1) Have your own mask which has been checked for fit by the oxygen officer.

(2) Carry your bail-out cylinder charged to 1800 pounds.

Figure 75 — Filling Portable Bottle

To recharge portable bottles, connect recharging nipples to the filler valve on any supply hose in the distributing lines.

Figure 76 — Disconnecting from Regulator

Remove the end connection of the mask hose from the fitting on the end of the feeder hose coming from the demand regulator.

(3) Check to see that there is a portable "walk-around unit at each station, filled to 400 PSI, and in working order.

(4) Check system pressure before flight; it should be 400 pounds per square inch.

(5) Check function of demand regulator in both "ON" and "OFF" positions. Flow gage should function when auto-mix is "OFF".

(6) Check knurled collar on elbow connecting mask hose to regulator for tightness.

(7) Open emergency valve to check flow; then close. This valve should not be open except in case of emergency.

(8) Turn regulator to auto-mix "ON" position.

Note

Turn auto-mix "OFF" only when treating men for shock, loss of blood, or as a protection against poisonous gas.

f. USE OF OXYGEN WITH AIRPLANE UNPRESSURIZED:

(1) Start using oxygen at 10,000 feet. At night use oxygen from ground up, with auto-mix "ON".

(2) In flight above 10,000 feet, always use "walk-around" unit when moving from one station to another.

(3) Remember the "walk-around" unit can be recharged from any main system filler valve.

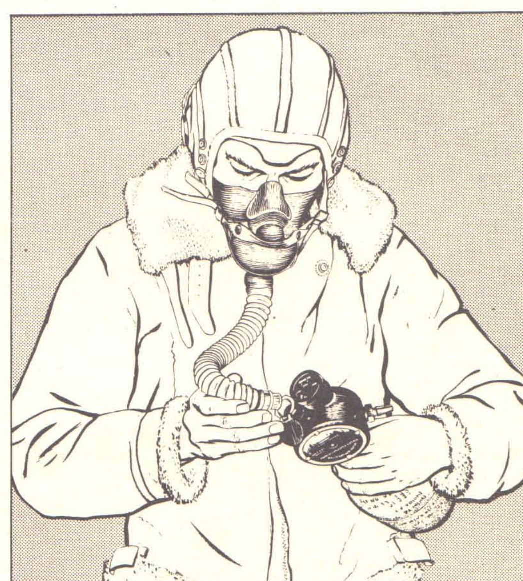


Figure 77 — Connecting Portable Bottle

Open the spring cover of the regulator connection and snap in the male fitting on end of the mask hose. Clamp portable unit to clothing.

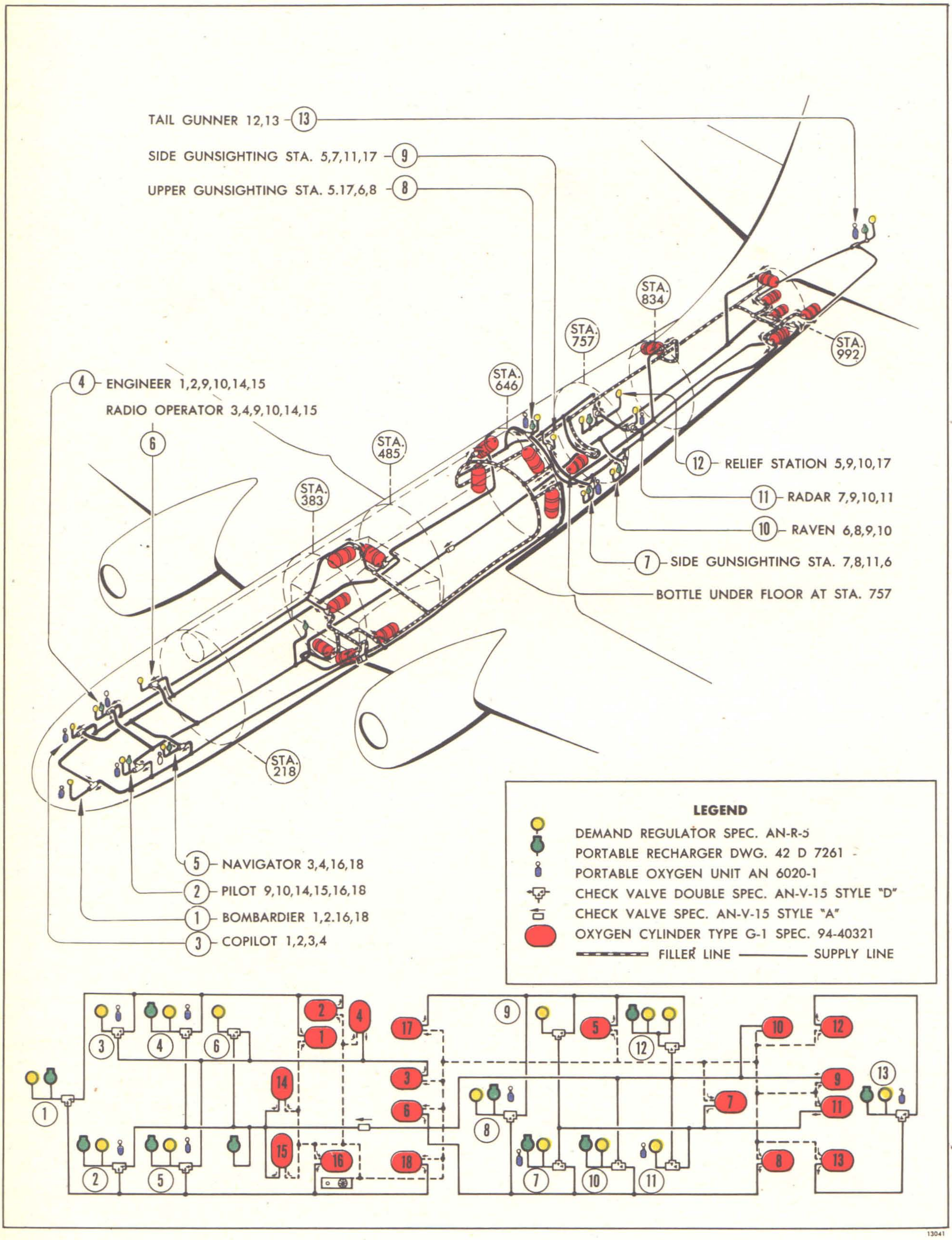


Figure 78 — Oxygen Flow Diagram

3. COMMUNICATION EQUIPMENT.

a. GENERAL.—The communication equipment comprises radio and interphone equipment arranged to provide communication with ground stations and other airplanes, intraplane communication, and reception of range and marker beacon signals. In addition, specialized equipment is provided for automatic radio direction finding and recognition and identification of friendly aircraft. Since the operation of this equipment is of a specialized nature, detailed instructions for its operation are not given here. Personnel unfamiliar with this specialized equipment should not attempt its operation. Instruction books are stowed in the forward cabin. The airplane's radio call numbers are located on the pilot's and copilot's instrument panels, command radio set mounting, and on each side of the vertical stabilizer.

b. LIAISON RADIO.

(1) TRANSMITTER.

(a) The liaison transmitter is mounted on the forward cabin right-hand sidewall adjacent to the radio operator's table and is normally used for communication with ground stations. It can also be used for inter communication between the crew members. The liaison transmitter has a frequency range of 200 to 500 kilocycles and 1500 to 12,500 kilocycles which is covered by three interchangeable tuning units. The two inactive tuning units are stowed beneath the radio operator's table.

CAUTION

Transmitter operation at cabin altitudes above 15,000 feet is subject to flash-over with some tuning units.

(b) A chart indicating the dial settings for the desired frequencies is mounted on the front of each tuning unit. The calibration of dial settings is close; however, it is possible to tune the transmitter to the exact frequency of an incoming signal in the receiver by means of a monitor switch located in the radio compass relay shield. With this switch in the "MONITOR" position, the transmitter sidetone is cut off and the receiver may be turned on and adjusted to receive the desired frequency. The transmitter key adjacent to the liaison receiver is depressed and the transmitter oscillator dial adjusted to "zero beat" with the incoming signal. The transmitter is then adjusted for maximum output and rechecked in the receiver.

(c) A similar procedure is followed when adjusting the transmitter frequency and checking with the frequency meter (SCR 211). The frequency meter is stowed aft of the engineer's control stand.

(d) When the monitor switch is in the "NORMAL" position the receiver will be silenced while the transmitter is in operation, and the transmitter sidetone signal will be present in the interphones.

(e) The transmitter may be modulated by either the pilot's, copilot's, or radio operator's microphone.

IMPORTANT

When the transmitter is operating, the filament voltage meter must read 10 volts (calibration mark on meter). The RF and modulator filament voltages are checked separately by a switch adjacent to the transmitter "ON-OFF" switch on the transmitter face.

(2) RECEIVER.—The receiver controls are mounted on its face. The "OFF-MVC-AVC" switch turns on the receiver and in addition allows choice of manual (MVC) or automatic (AVC) gain control. Tuning is best accomplished with manual gain control. After the signal has been tuned, the switch may be positioned for automatic gain control, if desired. Reception of "CW" signals should not be attempted with automatic gain control. Frequency band selection is accomplished by means of the band switch. Operation of this switch also changes the tuning dial calibration to correspond with the selected band frequencies.

(3) ANTENNA TUNING UNIT.—In order to provide efficient antenna loading, an antenna tuning unit is installed above the liaison transmitter.

(4) ANTENNAS.

(a) The liaison radio employs both a fixed and trailing antenna installation. Either antenna may be selected by means of the shielded antenna transfer switch, mounted on the cabin bulkhead above the radio operator's table.

(b) The fixed antenna installation utilizes the right-hand wing skin as a radiator. The antenna lead connection is made near the top of the No. 3 nacelle.

(c) The trailing antenna is 250 feet long and is wound on a motor-driven reel through an insulated fairlead, which may be extended angularly by a lever on the leg of the radio operator's table. The reel and fairlead are mounted on the aft portion of the forward bomb bay on the right-hand catwalk.

(5) TRAILING ANTENNA CONTROL. — The antenna reel motor control box is mounted on the cabin bulkhead above the radio operator's table. The control box contains an "IN-OFF-OUT" switch, a cable operated counter indicating the length of antenna paid out, and an amber light to warn the radio operator if the landing gear should be extended while the antenna is not retracted. A small knob is provided to set the zero of the antenna counter dial.

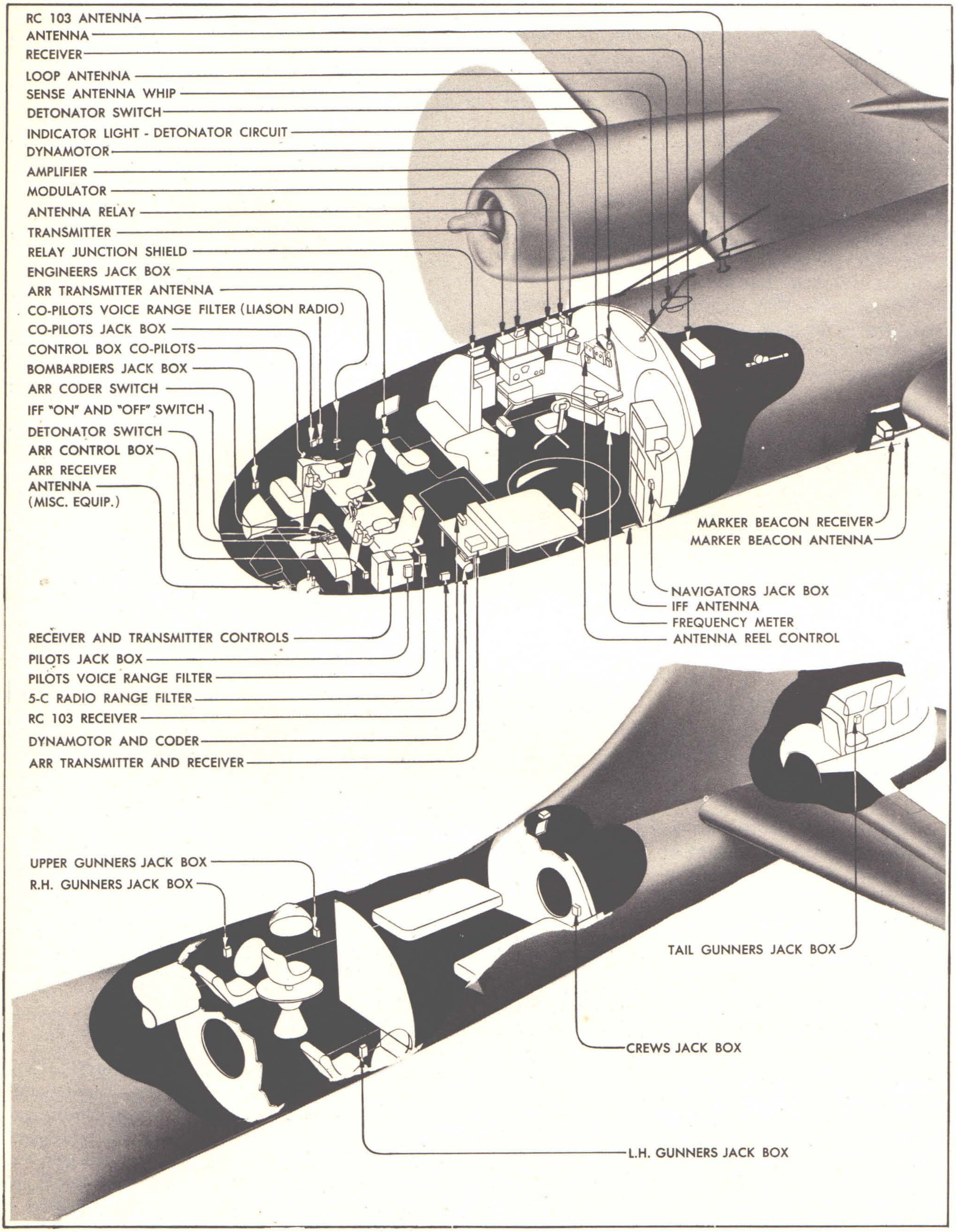


Figure 79 — Communication Equipment Diagram

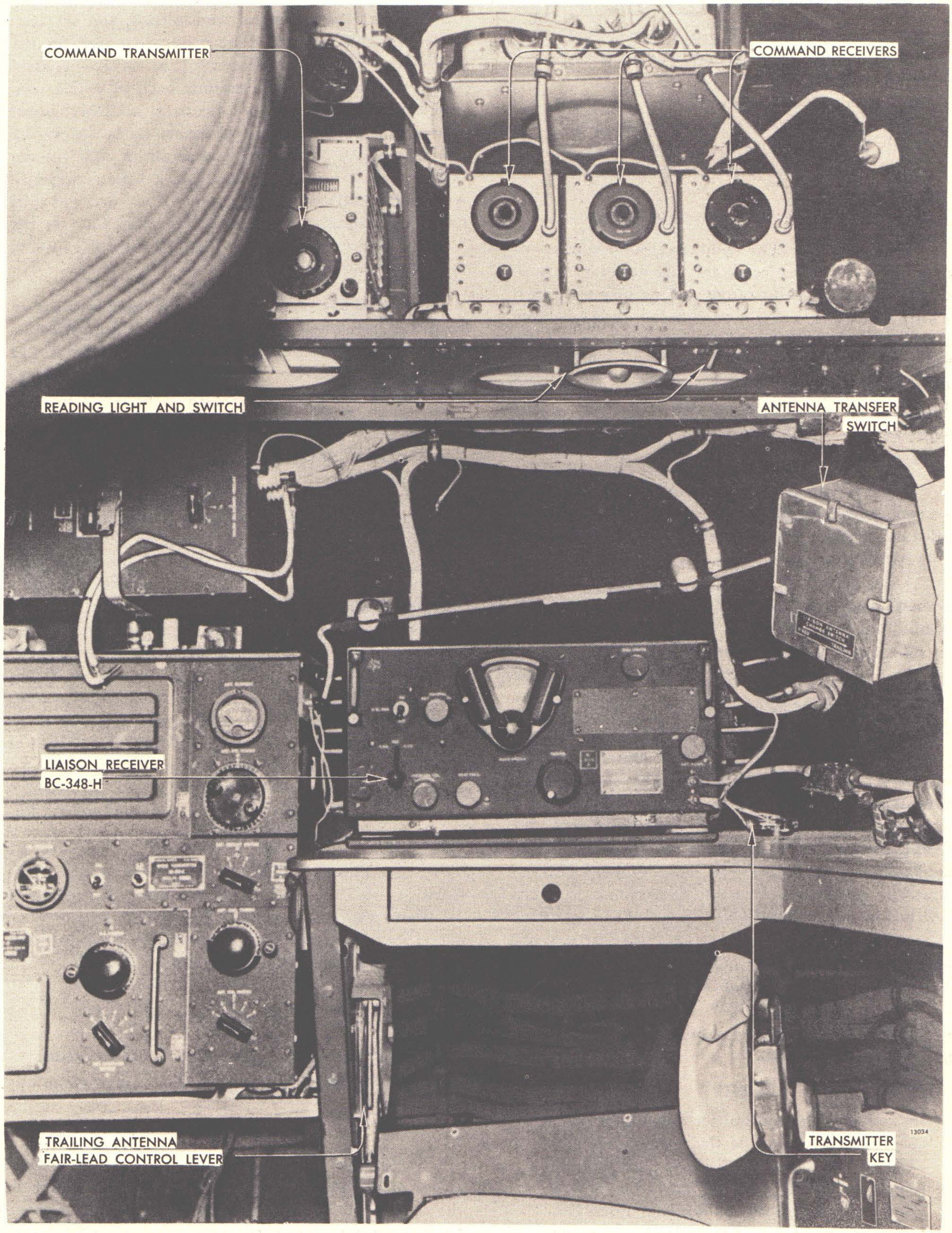


Figure 80 — Radio Operator's Station

DANGER

Do not make any adjustments within the command or liaison transmitters while the high voltage supply is "ON".
Do not remove or replace tubes in any of the radio equipment while the power supply is "ON". Do not remove covers from or replace fuses in any of the dynamotors while they are running.

c. COMMAND RADIO SET (SCR 274N)

(1) GENERAL.—The command radio consists of two transmitters, three receivers, and auxiliary equipment. These are of short range and are primarily used for airplane-to-airplane communication on the following ranges: the transmitting frequency ranges are from 4000 to 5300 kilocycles and from 7000 to 9100 kilocycles; the three receivers have ranges of 190 to 550 kilocycles, 3000 to 6000 kilocycles, and 6600 to 9100 kilocycles.

(2) TRANSMITTERS.

(a) The two transmitters are mounted together on a rack above the radio operator's table and are controlled by a control box mounted on the cabin side wall, at the pilot's station.

(b) Each transmitter is supplied with a special frequency-checking circuit. A plug-in crystal is used for checking the transmitter frequency only and does not control the transmitter frequency.

(c) The transmitter control box contains TRANSMITTER POWER, TRANSMITTER SELECTOR, and TONE-CW-VOICE switches.

(d) The transmitter selector switch allows a choice of operation with either transmitter. With the emission selector switch in the "CW" position, the transmitted signal will be unmodulated. In the "TONE" position, the signal is almost 100 percent modulated by a 1000-cycle note. The "VOICE" position allows the microphone for any interphone jack box (switched to the "COMMAND" position) to modulate the transmitter. For long-range communication through interference, the most effective operation is CW with TONE and VOICE following in that order.

(e) In both the "CW" and "TONE" position, the transmitter is keyed by a built-in key located on the top of the control box.

NOTE

Inasmuch as the transmitter dynamotor operates continuously while the selector is in the "TONE" or "CW" position, the selector should be left in "VOICE" to reduce power drain and promote dynamotor life, unless continued Tone or CW transmission is anticipated.

(3) RECEIVERS.—The receivers are mounted in a rack aft of the command transmitters, and are controlled by the receiver control box mounted on the base of the pilot's control stand. The receiver control box is divided into three sections, each of which controls a receiver by means of electrical and mechanical connections. The receivers are turned on by means of a CW-OFF-MCW knob which in addition will (in the "CW" position) superimpose a tone on the continuous wave (unmodulated) signals received. Voice and tone modulated signals are received with the knob in the "MCW" position. Controls for adjustment of gain and tuning are also provided.

(4) ANTENNA.—The radio antenna consists of approximately one-half of the wire extending from an insulator, at the radio operator's station, to the top of the vertical stabilizer. The antenna is coupled to the receivers and transmitters by a transmit-receive transfer relay mounted above the command transmitter.

d. RADIO COMPASS.

(1) GENERAL.—The radio compass (SCR-269-G) consists in general of a receiver mounted in the upper left portion of the forward bomb bay, two control boxes, one mounted at the copilot's and one at the radio operator's stations, a "CW-VOICE" switch, mounted adjacent to the copilot's control box, a relay switch to transfer control from one control box to the other, an automatic loop antenna located on the fuselage above the bomb bay, a retractable whip antenna aft of the forward upper turret, and two direction indicators, one mounted in the pilot's instrument panel and one in the radio operator's table. The radio operator's indicator has a variation knob by which he may compensate for magnetic deviation and variation before obtaining a bearing. A spare whip antenna is mounted on the forward side of the navigator's cabinet.

(a) The radio compass receiver is supplied 400-cycle 115-volt alternating current from the airplane's inverters, and has a frequency range of from 150 to 1750 kilocycles. The receiver may be operated on either the loop antenna or the whip antenna, or both.

CAUTION

Do not exceed an indicated air speed in excess of 240 miles per hour when the whip antenna is installed.

(b) The radio compass may be operated from either of the two control boxes but not from both at the same time. The equipment is mechanically tuned from the boxes. Electrical control for either box is established by depressing the button marked "CON-

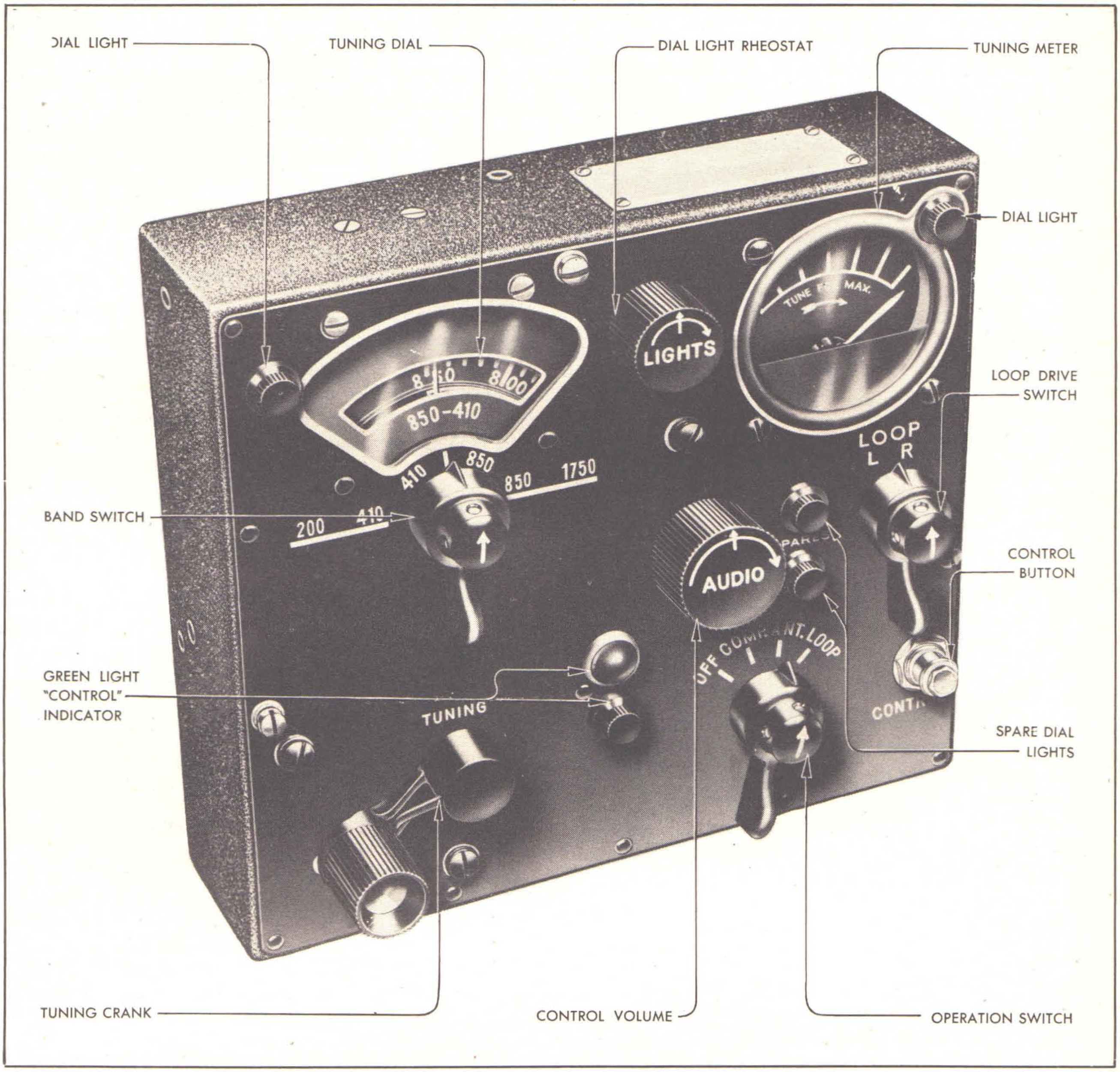


Figure 81 — Radio Compass Control Box

TROL" in the lower right-hand corner of the box. When control has been established a green light on the box will come on. A tuning indicator is provided as an aid to precise tuning. Also, controls are available for manual loop control, receiver volume control, band change, and mode of operation. This mode of operation switch has four positions, "OFF", "COMP", "ANT", and "LOOP".

(c) The "ANT" position is used when it is desired to receive aural signals, with the airplane's whip antenna, as when receiving radio 'range" signals. For the best definition of these signals set the interphone volume knob fully clockwise and adjust receiver volume (AUDIO) for minimum usable.

(d) If reception on "ANT" is difficult due to precipitation static, "LOOP" reception may be employed with possibly better results. The loop antenna should be rotated by means of the "LOOP L-R" knob for maximum signal. For reception of radio range signals this will occur near 90-degree or 270-degree loop bearings. Adjust volume as under "ANT" reception.

NOTE

Cone of silence indications with "LOOP" operation are not always reliable. In some cases an increase instead of decrease in signal strength will be noted.

(e) The "LOOP" position may be used also in the "aural-null" direction finding method. The "AUDIO" knob may be used to vary the width of the "null" point. The tuning meter may be used as a visual null indication, if desired. When determining direction with this method, it must be remembered that it is possible to obtain a null in a direction 180 degrees from the direction of signal reception.

(f) The "COMP" position is used for automatic direction finding. When so positioned, both the whip antenna and loop antenna are employed with the radio compass indicators showing an unidirectional bearing of the source of the radio signal received. This signal may be heard in the operator's headphones.

e. MARKER BEACON.

(1) The marker beacon receiver is located on the left hand side in the tail gunner's compartment along side of the ammunition can, and operates on ultra high frequency (75 mc.) signals. Its purpose is to indicate signals received from instrument landing markers, fan-type and cone of silence markers, and other facilities employing 75 mc. horizontally polarized radiation. The antenna is located on the left hand side of the tail skid and is coupled to the receiver by a coaxial transmission line.

(2) As the airplane pass through the radiation field (conical) of a marker beacon transmitter, the amber indicator lamp in the pilot's instrument panel will flash in synchronism with the transmitter keying. Operation of this equipment is automatic, the only requirement being that the radio compass receiver must be "ON" to supply the power.

f. INTERPHONE.

(1) GENERAL.—The interphone system (RC 36) provides communication between crew members at 11 stations throughout the airplane. In addition, the system allows crew members limited use of the radio facilities. The interphone jack boxes are provided for use by the following personnel: bombardier, pilot, copilot, engineer, navigator, radio operator, top gunner, side gunners (two), tail gunner and relief crew (one).

(2) JACK BOX.

(a) Each jack box contains microphone and earphone jacks, a volume control knob, and a five-position selector knob. The selector knob positions are labeled: "COMP," "LIAISON," "COMMAND," "INTER," and "CALL."

(b) With the selector in the "COMP" position, the output of the radio compass receiver may be heard.

(c) With the selector on "LIAISON," the output of the liaison receiver and transmitter sidetone may be heard. The liaison transmitter (VOICE operation) may be modulated at the pilot's, copilot's, and radio operator's stations only.

(d) With the selector on "COMMAND" the command receiver output and transmitter sidetone may be heard. The command transmitter (VOICE operation) may be modulated at any of the interphone stations.

(e) With the selector on "INTER", communication is possible with all other interphone jack boxes and their selectors similarly positioned.

(f) With the selector on "CALL" position, the microphone output will override the radio outputs and will be heard at all stations without regard to the position of their selector switches. A spring is provided to prevent the selector from being inadvertently left in the "CALL" position.

(g) The volume control provides limited control over the outputs of the radio receivers only, no control being exerted over the output of the interphone amplifier.

(3) MICROPHONES.—T-30 throat microphones are located at all stations. "Push-to-talk" microphone switches are located on the aileron control wheels for each pilot and in the sights for the gunners. All other stations are provided with standard cord switches except the engineer who is provided with a foot switch.

IMPORTANT

When using throat microphones, adjust the "buttons" to rest snugly on each side of the "Adam's apple." Speak distinctly and in a normal tone. Shouting will render speech unintelligible.

(4) AMPLIFIER. — The interphone amplifier is automatic in operation and is located on the shelf aft of the command radio receivers.

(5) DYNAMOTOR.—Amplifier plate voltage is supplied by a small dynamotor mounted adjacent to the amplifier. Inasmuch as there is no switch in either the amplifier or dynamotor, they will operate whenever the battery or generators are supplying power.

(6) FILTERS.—Filter switch boxes are mounted on the pilot's and copilot's oxygen panels. This filter is used to separate the weather (voice) signals from the range (1020-cycle tone) signals during their simultaneous transmission on the same frequency. The switch allows reception of weather signals only, beacon signals only, or both.

(7) ADAPTERS.—Headset adapters (MC-385-A or MC-385-B) are provided adjacent to the filter boxes at the pilots' stations on all airplanes equipped with low impendance head sets.

g. IFF RADIO (SCR-695)

(1) Operation of this equipment is automatic. ON-OFF switches are located on the top of the pilot's instrument panel and in the IFF control box (BC-648).

(2) Two detonator switches are provided adjacent to the pilot's ON-OFF switch. Their purpose is to destroy the equipment if it is found necessary to abandon the airplane. When both push buttons are depressed together, a small charge is exploded in the receiver which is located below the radio operator's table. The explosion is confined within the receiver housing. No injury to the personnel or structure is anticipated; however, contact with the receiver should be avoided.

(3) An automatic detonator switch is provided adjacent to the IFF control box, at the radio operator's station. This switch may be set to destroy the receiver when subjected to severe shock, such as would be experienced in a crash. Operation of this switch should not be relied upon; however, every effort should be made to use the manual switch should the necessity arise.

(4) The fixed stub antenna is mounted on the forward bomb bay left-hand door.

NOTE

Regeneration adjustment of the IFF set must be made on the ground prior to take-off, to insure and correct operation of the equipment.

h. RADIO RECEIVING EQUIPMENT RC-103

(1) The air-borne RC-103 receiver is located on a shelf in the enclosed section aft of the pilot's seat, and is designed to operate at six tuned frequencies of 108.3, 108.7, 109.1, 109.5, 109.9 and 110.3 megacycles. The receiver case back end is recessed to accommodate the dynamotor. Together, the unit functions as a mixer stage in which the incoming radio frequency is heterodyned with a frequency generated to produce the intermediate frequency. When the receiver is tuned to the field localizer transmitter, a 90- and 150-cycle modulation will be audible in the head set while the indicator located on the pilot's instrument panel will reproduce the signals visually. Unless the aircraft's antenna is exactly ON COURSE, the indicator needle will deflect to either the blue or the yellow side of the dial. If the indicator pointer is on the blue side of the indicator, the airplane is shown to be in the 90-cycle modulate blue area. Likewise, if the pointer is in the yellow area (150-cycle modulation) the aircraft is on the yellow side of the course. This is true regardless of the heading of the airplane so other references will have to be made to establish the correct heading when flying the localizer. A remote control box is provided at the pilot's station for monitoring the receiver, for tuning to any one of the six resonant frequencies, and for turning the receiver on or off. The monitoring circuit includes a volume control for adjusting the audio signal level in the operator's head set.

(3) A horseshoe shaped RC-103 antenna is located on the top of the fuselage above the wind center section.

i. OPERATING INSTRUCTIONS.

(1) RADIO NAVIGATION VARIABLES.

(a) When using radio equipment for navigational purposes, it must be remembered that although the equipment may be operating satisfactorily, erroneous indications may be obtained as the result of the following conditions:

1. Night effect or reflection of the radio wave from the sky is always present. It may be recognized by a fluctuation in bearings or by signal fading. The remedy is:

a. Increase altitude, thereby increasing the strength of the direct wave.

b. Take an average of the fluctuations or select a lower frequency station.

c. Night effect is worst at sunrise and sunset. Night effect may be present on stations at 1750 kilocycles at distances greater than 20 miles; as the frequency decreases, the distance increases, until, at 200 kilocycles the distance will be about 200 miles. Satisfactory bearings, however, will obten be obtained at much greater distances than stated above, and sometimes unsatisfactory bearings may be obtained at shorter distances.

2. The presence of mountain ranges, rivers, and the like will cause the patterns of the transmitter to be uneven and somewhat scalloped. This will produce erroneous or fluctuating bearings or multiple on-course signals which will sound exactly like the true on-course signals except that they will usually be bounded by identical quadrant letters. In some cases, the multiple will be like the true course or even with reversed signals.

3. The presence of a bend in a radio range quadrant leg is due to the same topographical irregularities which cause multiples.

4. When a radio wave travels through a cold front, erroneous and fluctuating bearings may result to a limited extent.

5. Station interference between two or more stations on the same frequency may result in erroneous indications. Clear channel stations are always preferable. If clear channel stations cannot be used as a reference, a stable station widely separated by distance from other stations on the same frequency is desirable.

6. Where a radio range signal crosses an irregularity in terrain, such as a deep canyon, there may exist a false cone of silence. As the radio waves pass over such an irregularity, some of the waves will be reflected back from the far wall. The reflected waves serve to cancel the direct waves when over the canyon, and cause the signal to disappear momentarily. False cones may change in character at different times of day. Additional Heaviside reflection may obscure the false cone at night. A true cone of silence produces a definite increase in volume just before entering and just after leaving the cone. The quadrant signal to the right after emerging from a true cone of silence is not the same as that received before entering the cone.

7. For the best definition of A-N radio quadrant signals the interphone jack box "INCREASE OUTPUT" control must be in a fully clockwise position, and the head-set volume level should then be adjusted by means of the control box volume control in accordance with the following considerations:

a. At extremely low volume levels which are just above the threshold of audibility, the ear cannot easily distinguish difference in the volume of the "A" and "N" signals. When flying on the edge of the on-course it is very desirable to detect small differences between the "A" and "N" signals. Consequently, the volume level should be set high enough to give a loud but not unpleasant signal.

b. Radio set SCR-274-N and radio compass SCR-269 have delayed automatic gain and control provision incorporated in their design. This can be stated as a feature providing for a fixed output level effective only after a predetermined high level has been reached through clockwise adjustment of the control box volume control. When the AVC feature is active, true representation of "A" and "N" signal input is not possible, and errors may be introduced into radio range navigation.

c. In view of the above considerations it can be seen that the head-set volume level should be adjusted to a minimum usable. This can be determined by listening to a signal which is slightly off the "on-course" zone and adjusting the head-set volume to give the best audible ratio between signals.

d. It can be seen from the above discussion of variables that the question of accuracy of radio navigational equipment indications should, if possible, be subjected to a check against navigation data obtained by other means.

(2) PILOT'S AND COPILOT'S POSITION.

(a) GENERAL—OPERATION INSTRUCTIONS.

1. If the airplane is not in flight, either an external source of power or the auxiliary power plant must be used to supply power for operation of the communication equipment. A standard three prong, external power receptacle is installed in aft wall of the No. 2 nacelle wheel well on early airplanes and in the nose wheel well on later airplanes, for plugging in the power supply from a portable generator. When using an external source of power, battery and ignition switches must be in "OFF" position.

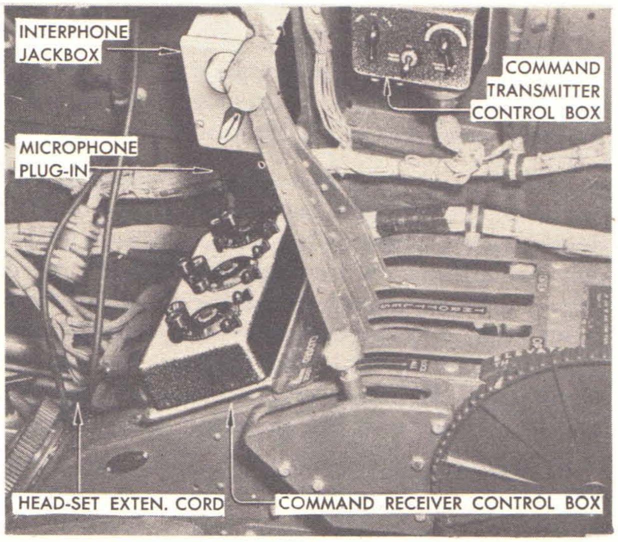


Figure 82 — Pilot's Radio Controls

2. The auxiliary power plant is installed aft of the rear pressurized cabin on the left side. (See Figure 65.) To start auxiliary power plant:

a. Place throttle lever (Figure 47) in "IDLE" position.

b. Place auxiliary power plant ignition switch (Figure 47) "ON".

c. Place generator switch (Figure 47) in "START" position.

d. As soon as the auxiliary power plant starts firing place generator switch in "OFF" position. When the power plant oil gage indicates operating temperature, move throttle to "RUN" and generator switch to "ON". If engine or engines are running turn equalizer switch to "ON".

e. Place double throw "EMERGENCY" ignition switches (Figure 105) and battery switch (Figure 12) "ON".

f. When operation of the radio compass is desired, the AC inverter switch (Figure 12) must be "ON" to furnish the AC power necessary for the operation of the loop-drive components of the equipment. When operation of the communications equipment is completed turn off these switches and turn off auxiliary power unit.

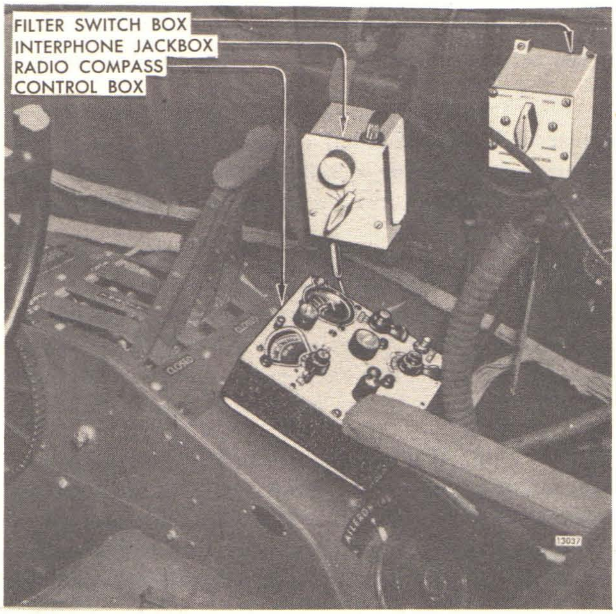


Figure 83 — Copilot's Radio Controls

3. PLUG HEAD SET into head-set disconnector cord jack. (See Figure 82.) (This cord extends from filter switch box.) PLUG THE THROAT MICROPHONE into microphone disconnector cord jack. (See Figure 82.) (Cord must be plugged into the interphone jack-box "MIC" jack as in figure 82.)

4. Set the interphone jack-box (Figure 82) selector switch on the applicable position and turn the "INCREASE OUTPUT" knob fully clockwise.

5. Set filter switch box (Figure 83) selector switch on "BOTH". If rejection of radio range quadrant signals is desired, set on "VOICE". If reception of radio range quadrant signals with rejection of voice modulation is desired set on "RANGE".

(b) TO OPERATE INTERPHONE TYPE RC-36.

1. The interphone amplifier is in operation when an external power plant is being used or when battery and ignition switches are on. (Audio output of the command receivers, compass receiver, and liaison receiver can be heard over the interphone system without the interphone amplifier being operative, but no output over the interphone system when on either "INTER" or "CALL" will be heard, unless the interphone amplifier is energized.)

2. Hold the interphone jack-box selector switch (Figure 82) in "CALL" position, call desired crew member, and release selector switch, allowing it to return to "INTER".

3. When the crew membr eanswers, intercommunication may be carried on with the selector switch on "INTER".

Note

The interphone jack-box volume control provides limited control over the outputs of all positions except "INTER" and "CALL".

4. On the aisle stand between the pilot and copilot is located a phone call switch. (See Figure 11.) In the aft pressurized compartments there is a call light mounted by each interphone jack-box. By use of the phone call switch the pilot can signal the crew members in these compartments to listen on interphone.

(c) ADJUSTMENT OF THROAT MICROPHONE TYPE T-30

1. The throat microphone neck band length should be adjusted to allow the microphone elements to bear firmly but not tightly against the throat. For best results the microphone elements should be equally spaced beside the "Adam's apple". Do not allow clothing to get between the microphone elements and the skin of the wearer. Speak in a normal tone of voice.

(d) TO OPERATE COMMAND RADIO SET—SCR-274-N.

1. RECEIVING COMPONENTS.

a. Set the three "A-B" switches on the receiver control box (Figure 82) to "A". These switches have no function in this installation on "B" position.

b. Select section of the receiver control box covering the desired frequency band.

c. Turn the "CW-OFF-MCW" switch to the type of reception desired.

d. Turn tuning crank to desired station frequency.

e. Set head-set volume to desired level by adjusting the "INCREASE OUTPUT" knob.

Note

Two or more frequencies, each peculiar to one receiver, may be monitored at one time by appropriate adjustment of head-set volume levels.

f. To turn off receiver throw "CW-OFF-MCW" switch to "OFF".

2. TRANSMITTING COMPONENTS.

a. Monitor the frequency of the desired answering station before transmission is effected.

b. Turn "TRANSPOWER" switch on transmitter control box (Figure 82) "ON".

c. Set frequency selector switch to the desired frequency as indicated on placard above switch.

CAUTION

M. O. control "B" must be set in accordance with the Calibration Chart and locked.

(2) Disconnect transmitter antenna.

(3) Place filament voltage switch in tube compartment in appropriate position.

(4) Place frequency meter in proximity of transmitter. (The frequency meter is located at aft end of forward pressurized compartment, on right side, lashed to the floor in a horizontal position. The unit is easily removed for use by unbuckling a single strap.

(5) Place frequency meter in operation and turn on transmitter by throwing "OFF-ON" switch to "ON". (Do not apply transmitter plate voltage).

(6) Tune transmitter with transmitter antenna disconnected.

(7) Set frequency meter on 11,800 kilocycles in accordance with the operating instructions and calibration chart furnished with the frequency meter.

(8) Open the calibration reset port located on the front panel between the TEST KEY and "TONE-CW-VOICE" switch, insert a screw driver and rotate the calibartion screw until the transmitter frequency coincides with that of the frequency meter. Obtain minimum PLATE CURRENT and adjust calibration if necessary until transmitter frequency is set with that of the frequency meter while the PLATE CURRENT meter reading is at minimum value.

(9) Close the calibration reset port. The transmitter is now properly calibrated for any of its tuning units.

(10) Tune transmitter as instructed.

f. To obtain dial settings for frequencies falling within the limits of those shown on the Calibration Chart, but not specifically shown thereon, interpolation of dial settings is necessary. (See figure 85).

(1) Desired operating frequency is 2589 kilocycles.

(2) Dial setting "B" (figure 85) for nearest listed higher frequency—2600 kilocycles—is 1289.

(3) Dial setting "B" (figure 85) for nearest listed lower frequency—2500 kilocycles—is 1035.

(4) Frequency and dial setting variation —100—254.

(5) Dial variation per kilocycle—2.54.

(6) Interpolation multiplier = 2589—2500 = 89.

(7) Interpolation product (dial units) = 2.54 x 89 = 226.

(8) Interpolated dial setting 1035 + 226 = 1261.

(9) Set "B" to 2589 by rotating units dial (figure 85) until a reading of 12 is obtained on the hundreds scale (figure 10) and a reading of 61 is obtained on units scale (figure 85).

(f) OPERATION OF FREQUENCY METER SET SCR-211-( )

1. GENERAL.

Inexperienced personnel should not attempt checking frequency of BC-375-( ) transmitter.

a. Secure an antenna, preferably a rigid wire not over two to three feet long, to the antenna terminal on top of the frequency meter cabinet. (Flexible insulated wire may be used).

b. Plug head set in the phones jack (figure 86); turn the power switch (figure 86) to "CRYSTAL" position. (Head-set extension cord must be plugged in to complete d-c power circuit to vacuum tubes). Allow vacuum tube filaments to warm for at least 10 minutes or longer, if necessary as indicated by the drifting of the beat note.

Note

Some frequency meters have a power "OFF-ON" switch and a "CRYSTAL "OFF-ON" switch.

c. From high or low frequency indices on front and rear covers of calibration book (figure 86) determine in which band desired frequency is located and set "FREQ BAND" selector switch (figure 86) to correspond.

d. Locate, in the calibration book, the heterodyne oscillator calibration for frequency desired. At bottom of the page will be found the crystal check point (in red) (figure 86), together with the heterodyne tuning dial setting (figure 86).

e. To set heterodyne tuning control to any desired crystal check point, rotate tuning control until the following readings are observed: (Using 5700 kilocycles as an example for this frequency, the crystal check point is 2070.5).

(1) The "DIAL HUNDREDS" scale (figure 86) should read "20".

(2) The "DIAL UNITS" scale (figure 86) should read "70".

d. Set the "TONE-CW-VOICE" switch to the type of emission desired.

e. If "TONE" or "CW" emission is selected, transmit with "PUSH-TO-TALK" switch on the control wheel.

f. If "VOICE" emission was selected, transmit by pressing the "PUSH-TO-TALK" switch on the control wheel and speaking slowly and distinctly in a normal tone of voice.

g. If for any reason the hand microphone type T-17 is used, make sure the protruding knurled nut at "MIC" jack is turned fully counterclockwise and left in that position as long as T-17 remains in use.

h. During flight the "TRANSPOWER" switch on the transmitter control box is usually kept "ON" to keep the transmitter tube filaments warm and ready for instant use. The emission selector switch should always be kept on "VOICE" position except when it is desired to transmit code, as in the "CW" and "MCW" positions the dynamotor is running continuously, resulting in dynamotor overheating and consequent equipment failures. "In "VOICE" position the dynamotor runs only when the "PRESS-TO-TALK" switch is closed.

i. In the event of interphone equipment failure the audio frequency section of the command transmitter may be substituted for the regular interphone amplifier. To make this connection the pilot should place his command transmitter control box channel selector switch in either No. "3" or No. "4" positions. (See Figure 81). Set interphone jack-box selector switches on "COMMAND" and operate as if selector switches were on "INTER".

Note

In this position it is not possible to establish communication with ground station or any aircraft. To resume normal command set operation place channel selector switch back in either No. "1" or "2" position.

j. To turn off transmitter, throw "TRANSPOWER" switch to "OFF".

(e) TO OPERATE RADIO COMPASS SCR-269..

1. GENERAL.

a. This equipment provides for:

(1) Aural reception of modulated or unmodulated radio frequency energy, using a nondirectional antenna, when operating on the "ANT" position of the selector switch.

(2) Aural reception (at a net gain of snow static reduction and a loss of signal strength as compared to operation on "ANT") of modulated or unmodulated radio frequency energy, using a shielded loop antenna, when operating on the "LOOP" position of the selector switch.

(3) Aural null directional indications of the arrival of modulated or unmodulated radio frequency energy, using a loop antenna, when operating on the "LOOP" position of the selector switch.

(5) Automatic bearing indications, with regard to the longitudinal axis of the airplane, of the direction of arrival of radio frequency energy and simultaneous aural reception of modulated or unmodulated radio frequency energy, when operating on the "COMP" position of the selector switch.

b. When using the radio compass as a homing device the indications are such that the aircraft will ultimately arrive over the radio station antenna regardless of probable drift due to cross-wind. However, the flight path will be a curved line, and coordination with ground fixes or landing field along the route will be either difficult or impossible. Consequently, it is often expedient to fly a straight-line course by offsetting the aircraft's heading to compensate for wind drift. To do this, determine the wind drift, either with a drift sight or by noting the change in magnetic compass reading over a period of time, while homing with the radio compass.

c. Complete the necessary operations included in *a,* (2), *(d), 2,* a.

d. If airplane is not in flight, turn on inverter selector switch (engineer's station) and when operation of the radio set is completed, turn this switch off.

e. This operating procedure may be performed at either the copilot's or radio operator's positions. To assume control at either position, the selector switch (Figure 81) on either radio compass control box must be turned to the type of operation desired and the "CONTROL" button (Figure 81) must be pressed until the group control indicator lamp(Figure 81) lights. If the copilot desires to obtain a radio fix, it will be desirable to have radio operator compensate for magnetic deviation and variation and take the bearing readings with the I-82-A compass indicator mounted on the radio operators table.

f. Dial lamps may be turned on and their brilliance controlled by means of the "LIGHTS" control on the compass control box. (See Figure 81.)

g. Head-set volume may be regulated by means of the "AUDIO" control. (See Figure 81.)

h. Select station frequency with band selector switch and tuning crank. Move tuning crank to

a position producing greatest clockwise indication of tuning meter. The tuning meter (Figure 81) should not be construed to be a distance indicator.

i. Provision is made for aural reception of "CW" signals. Control of this feature is provided by the "CW-VOICE" switch on the panel of the radio compass receiver and by the remote "CW-VOICE" switch adjacent to the copilot's compass control box. With the "CW-VOICE" switch in "VOICE" position the compass and homing components of this equipment will function properly while receiving "CW" signals, but aural identification of such signals will be impossible unless the "CW-VOICE" switch is set on "CW".

2. To operate as a receiver only, using the non-directional fixed sense antenna:

a. Set the selector switch (Figure 81 on "ANT".

b. Set band band selector switch to desired band and tune in desired station by means of tuning crank, making final adjustment by referring to tuning meter.

c. Regulate the head-set volume by adjusting "AUDIO" control.

Note

If reception on "ANT" is noisy due to precipitation static, commonly known as rain or snow static, operate on shielded loop antenna. Precipitation static existing in air mass fronts at different temperatures can sometimes be avoided by crossing the front at right angles, and then proceeding on the desired course, instead of flying along the air mass front.

d. To turn off radio compass, turn selector switch on compass control box to "OFF".

3. To operate as a receiver only, utilizing the shielding provision of the loop antenna to reduce precipitation static noises:

a. Set the selector switch on "LOOP".

b. Tune in desired station.

c. *Depress* "LOOP L-R" knob (Figure 81) on the radio compass control box and turn it to "L" or "R", rotating loop to obtain maximum signal strength as indicated by head-set volume. *Release* "LOOP L-R" knob and make final adjustment of loop position at slow speed by turning the knob to "L" or "R". Changing course will affect signal strength and necessitate readjustment of the loop position.

d. Regulate head-set volume with the "AUDIO" knob.

Note

If the loop is in null (minimum signal) position when flying on a radio range course, the signal may fade in and out and possibly be mistaken for a cone of silence. When operating on "LOOP", cone of silence indications from radio range stations employing loop-type radiators (shown on radio facility chart) are not reliable. The signal may increase in volume to a strong surge when directly over the station instead of indicating a silent zone.

e. To turn off radio compass, turn the selector switch on compass control box to "OFF".

4. To operate as an aural null homing device, utilizing the directional characteristics of the loop antenna:

a. Set the selector switch on "LOOP".

b. Tune in desired (preferable clear channel) station.

c. If compass indicator pointer (Figure 100) mounted on pilot's instrument panel is not at zero, *depress* the "LOOP L-R" knob and turn it to "L" or "R" position until the pointer rests on zero. Final adjustment of loop position can be made at slow speed by *releasing* "LOOP L-R" knob and turning it to the "L" or "R".

d. Turn the "AUDIO" control fully clockwise and head airplane in proper direction, based upon the null (point where a sharp minimum or loss of signal is found) indicated in the head set. (The broadness of the null depends on the strength of the signal. Strong signals produce very sharp nulls, sometimes as small as one-tenth of a degree). Vary "AUDIO" control until the null is of satisfactory width. The tuning meter may be used as a visual null indicator.

Note

When determining direction of flight by this method, it must be remembered that a 180-degree ambiguity exists, in that the airplane may be flying either directly TOWARD or directly AWAY FROM the station. If the direction of flight with regard to this ambiguity is not known and the radio compass is inoperative on the "COMP" position, a standard orientation procedure will have to be executed before flying any great distance along the null.

e. To turn off radio compass, turn selector switch on compass control box to "OFF".

5. To operate as a homing compass, utilizing the unidirectional characteristics of the radio compass when operating with both the sense and loop antennae.

a. Set the selector switch on "COMP".

b. Tune in desired station.

c. Apply rudder in direction shown by radio compass indicator (Figure 100) until the pointer centers on zero. This indication is unidirectional; as long as pointer rests on zero the airplane is headed toward the transmitting antenna of the radio station.

d. Regulate head-set volume by adjusting "AUDIO" control.

e. Since a pronounced AVC action may be present when operating the radio compass on "COMP", aural indications received on this position should not be used when homing on a radio range station.

f. To turn off radio compass, turn selector switch on the compass control box to "OFF".

6. To operate as a direction finder for the purpose of establish a fix.

a. GENERAL.

(1) The usual method of establishing a fix is by triangular plotting of three bearings obtained on three radio stations. Prior to making fix determinations, stations to be used should be located on a map, tuned in, identified, and dial reading logged. This avoids delay and error at the time of obtaining the fix.

(2) For best accuracy several bearings should be taken in rapid succession thereby eliminating error caused by the distance traveled between bearing observations. Bearings cannot be accurate unless the aircraft is held on a steady heading.

(3) When close to a station, accurate bearings cannot be taken with the aircraft in a steep bank. This is especially applicable to reception of signals from instrument landing trucks.

(4) Only head-on bearings are entirely dependable. If side bearings are taken, keep the wings horizontal.

(5) Do not depend on two stations for a fix of location; at least three station bearings should be used. In general a set of stations with bearings spaced at approximately equal intervals throughout 360 degrees will give best accuracy.

(6) In compensating for magnetic variation (declination), it must be remembered that the variation indicated on the geographic compass rose (printed on the map) of the radio station on which the bearing is being taken is the figure normally used. The magnetic variation of the locality over which the airplane is flying at the time the bearing is taken is not generally known. However, if this figure is used, the station compass rose variation figure should be excluded. In obtaining bearing for plotting on radio direction finding maps (D.F. maps), the variation should be excluded from the computation, as the compass roses on these charts are offset to compensate for magnetic variation.

b. AUTOMATIC VISUAL DIRECTION FINDING.

(1) With the radio compass selector switch on "COMP", tune the first station, previously logged and identified, and record the reciprocal reading of radio compass indicator pointer on pilot's instrument panel, which is the station-to-airplane bearing.

(2) Rapidly repeat operation *(1)* to obtain two additional station-to-airplane bearings.

(3) To the station-to-airplane bearing obtained in *(1)* *add* the magnetic compass heading of the airplane (referring to the compass correction card attached to the magnetic compass in order to obtain a true magnetic heading).

Note

If radio operator is taking the bearing, he may compensate for the magnetic deviation and variation on the I-82-A indicator before obtaining the bearing.

(4) Refer to the air navigation chart and obtain the magnetic variation (declination) for the locality of the radio station involved in operation *(1)*.

(5) If the magnetic variation for the locality is shown as easterly, *add* the indicated amount of variation to the result of operation *(3)*. If the variation is shown as westerly, *subtract* the indicated amount of variation from the result of operation *(3)*.

Note

When using direction finding (D. F.) maps, omit operations (4) and (5) as the compass roses surrounding the geographical locations of the radio stations are offset to compensate for magnetic variations.

(6) If the resultant sum of operation *(5)* is larger than 360 degrees, subtract 360 degrees from the result of operation *(5)* to obtain the correct station-to-airplane bearing. Plot this result on the map. (See Figure 84).

(7) With each of the two additional station-to-airplane bearings obtained in *(2)*, repeat operations *(3)*, *(4)*, *(5)*, and *(6)*, using the bearings obtained in operation *(2)* in each case.

(8) When the three bearings are plotted on a map at the proper angle, indicated by the compass roses, the lines should intersect. This point of intersection is the approximate location of the airplane at time of observation. See figure 84).

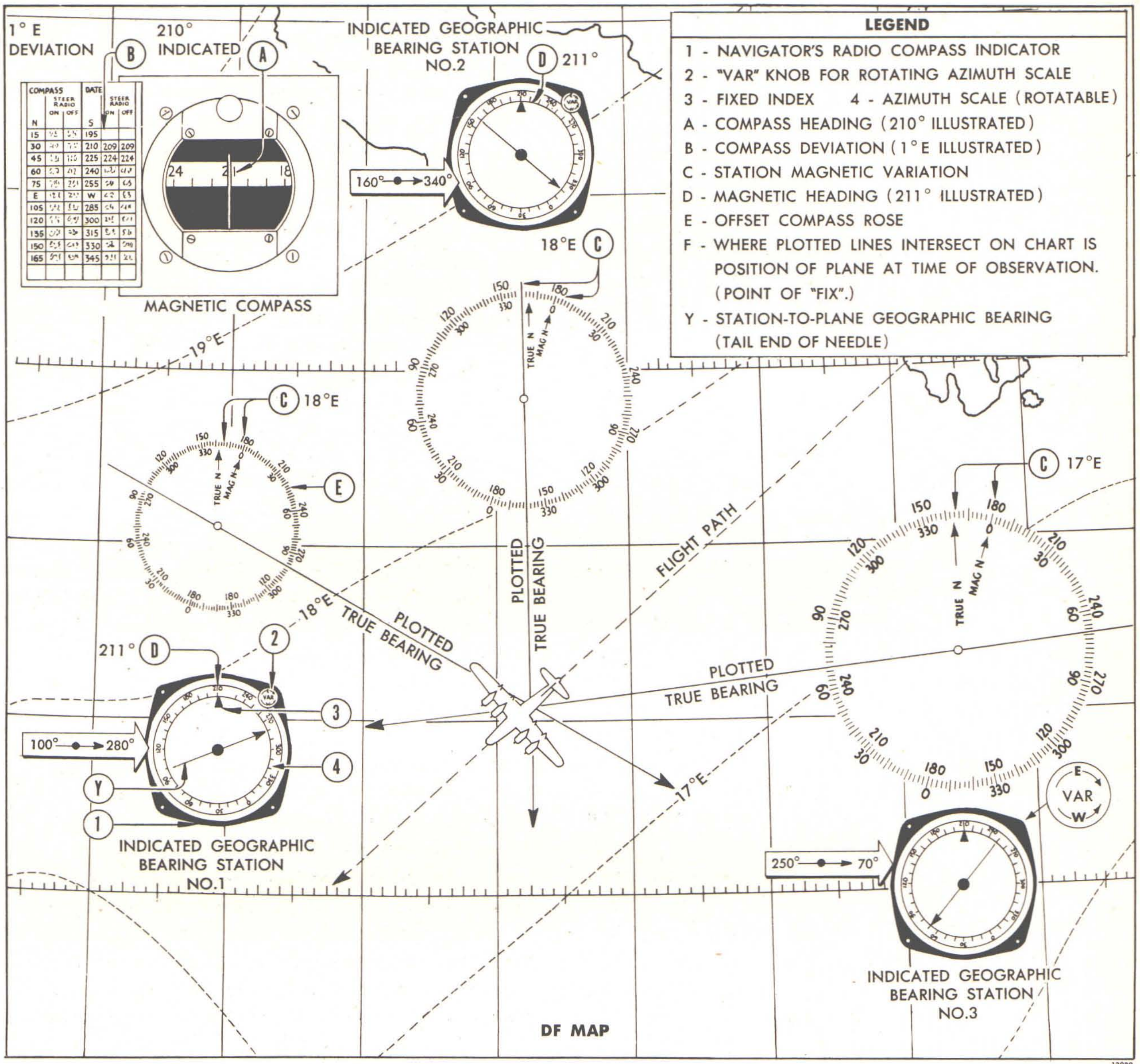


Figure 84 — Plotting Radio Compass Bearings to Obtain a Fix

c. AURAL NULL DIRECTION FINDING

(*1*) Set the selector switch on "LOOP".

(*2*) Tune in desired (preferable clear channel) station.

(*3*) Turn "AUDIO" control fully clockwise, *depress* "LOOP L-R" knob and turn it to "L" or "R", rotating loop in proper direction to null position indicated by minimum head set signal volume or tuning meter dip. Release "LOOP L-R" knob and make final adjustment of loop position at slow speed by turning knob to "L" or "R".

(*4*) Record the station-to-airplane bearing indicated by reciprocal reading of radio compass indicator pointer.

(*5*) Rapidly repeat operations (*2*), (*3*), and (*4*) in order to obtain two additional station-to-airplane bearings.

(*6*) To the station-to-airplane bearing obtained in operation (*4*), *add* the magnetic compass heading of the airplane (referring to the compass correction card attached to the magnetic compass, in order to obtain a true magnetic heading).

(*7*) Refer to the air navigation chart and obtain magnetic variation (declination) for locality of radio station involved in operation (*4*).

(*8*) If magnetic variation for locality is shown as easterly, add indicated amount of variation to result of operation (*6*). If variation is shown as

westerly, *subtract* indicated amount of variation from result of operation (*6*).

Note

When using direction finding (D. F.) maps, omit operations (7) and (*8*) as compass roses surrounding the geographical locations of radio stations are offset to compensate for magnetic variations.

(*9*) If resultant sum of operation (*8*) is larger than 360 degrees, subtract 360 degrees from result of operation (*8*) to obtain correct station-to-airplane bearing. Plot this result on map.

(*10*) With each of two additional station-to-airplane bearings obtained in operation (*5*), repeat operations (*6*), (*7*), (*8*), and (*9*), using bearings obtained in operation (*5*) in each case.

(*11*) When the three bearings are plotted on a map at the proper angle, indicated by compass roses, lines should intersect. This point of intersection is approximate location of airplane at time of observation. (See figure 84).

(*12*) Bearings obtained by aural - null method are subject to 180 degrees ambiguity. Where 180 degrees ambiguity exists, the bearing lines plotted on the map will indicate an airplane-to-station (rather than a station-to-airplane) bearing and they will fail to intersect. When it is clearly evident that 180 degrees ambiguity exists, the reciprocal bearing may be plotted. In other cases of doubtful correctness, the bearing may be retaken.

(*13*) To turn off radio compass, turn selector switch on the compass control box to "OFF".

(*f*) TO OPERATE MARKER BEACON RECEIVER RC-43.

1. Turn on radio compass which furnishes power for marker beacon receiver.

2. When flying over an airway fan marker or "Z" (cone of silence) marker (indicated on radio facility chart) or an instrument landing marker, the indicator lamp (figure 101) will light.

3. The interval during which the marker beacon indicator lamp will be lit varies from a few seconds to as long as several minutes, depending upon the type of marker, as well as the altitude and speed of the airplane. Cone of silence markers utilize non-directional antenna arrays which cause equal indications for any direction of flight. Indications over cone of silence markers last about 1 minute at 10,000 feet altitude, when the speed of the airplane is 150 miles per hour.

4. When passing over a marker, the indication should be steady or flash regularly, following the keying of the transmitter. Cone of silence markers and Army instrument landing markers are not keyed. Fan type markers and C. A. A. instrument landing markers are not identified by keying. The radio receiver may not follow the keying of the 100-watt fan marker transmitters when the airplane is passing through the strongest part of the beam at low altitudes. Turn off the radio compass to turn the marker beacon receiver off.

(*g*) TO OPERATE RC-103-A RECEIVING EQUIPMENT.—This equipment includes receiver BC-733 for lateral guidance during blind landing operations, and receiver R89/ARN-5 for vertical guidance. One indicator, one control box, and one antenna serve both receivers. On the indicator, lateral guidance is indicated by the vertical needle; vertical guidance is indicated by the horizontal needle.

1. Turn on the ON-OFF switch on the control box about 20 minutes before runway approach to warm up the receievrs. The ON-OFF switch is the only control for the ARN-5 equipment.

2. Turn the frequency selector switch for the RC-103 receiver to the desired position. Put the interphone jack box selector switch on COMMAND; turn the volume control fully clockwise; adjust the headset volume with the INCREASE VOLUME knob.

3. Observe the course indicator. If the horizontal needle is above center when the airplane is headed toward the runway, the airplane's nose must be raised to regain the center of the glide path. If the vertical needle is to the left when the airplane is headed toward the runway, the plane must go to the left for correction.

4. If the receiver giving vertical guidance fails or if the signals fail, the automatic alarm circuit in the ARN-5 receiver will cause the horizontal needle to deflect up and remain up; if the power supply to the ARN-5 receiver fails, the horizontal needle will remain in the center of the meter face regardless of the position of the airplane.

5. When the airplane is directly in line with the runway, the vertical needle will be centered. A deviation of ¼-scale to right or left of center is not too great for a successful landing. Corrections in the direction of the airplane should be made very slowly, when the deviation of the vertical needle is greater than ¼-scale, to avoid overshooting the localizer path.

(*h*) TO OPERATE LIAISON RADIO SCR-287-A

1. GENERAL.—The liaison radio set can be operated by the pilot and copilot only after operating adjustments have been made by the radio operator.

2. RECEIVING AND TRANSMITTING COMPONENTS

a. Instruct the radio operator to make operating adjustments of liaison receiver and transmitter.

b. Set the interphone jack box on "LIAISON" and receive and transmit by conventional use of head set, "INCREASE OUTPUT" control (on interphone jack box), and the microphone.

c. When comunication is finished, instruct radio operator to turn off equipment and, if necessary, to reel in trailing antenna.

(i) OPERATION OF IFF RADIO SET SCR-595 OR SCR-695

1. OPERATING COMPONENTS

a. Turn "ON-OFF" switch on the IFF control box at the radio operator's position or at the pilot's position (figure 87) to "ON".

b. Set selector switch on control box to numbered position designated by tactical orders.

c. If "EMERGENCY" operation is desired, place "EMERGENCY" switch (figure 87) to "ON".

d. To turn off the radio set, turn the "ON-OFF" switch to "OFF".

2. DESTRUCTOR COMPONENTS.—If necessary to destroy the IFF radio set, simultaneously press two switch buttons (figure 87) on the destructor switch.

Note

The above switch is paralleled by an automatic inertia-type switch which is mechanically energized by a crash landing.

(k) OPERATION OF PORTABLE EMERGENCY RADIO TRANSMITTER SCR-578-A

1. GENERAL

a. A complete self-contained portable emergency transmitter is provided for operation anywhere away from the airplane. Primarily designed for use in a small boat or life raft, it may be placed in operation anywhere. The unit is equipped with a small parachute to permit dropping from airplane in event of an emergency.

b. When operated, the transmitter emits an "MCW" signal and is pretuned to the international distress frequency of 500 kilocycles. Automatic transmission of a predetermined signal is provided. Any searching party can home on the signal with the aid of a radio compass.

c. No receiver is provided.

2. REMOVAL FROM AIRPLANE

a. If the airplane has made an emergency landing on water, the emergency set should be removed at the same time that the life raft is removed. The set is waterproof and will float; therefore, it is not necessary to take any precautions in keeping the equipment out of the water. Be sure that it does not float out of reach.

b. The emergency set may be dropped from the airplane by use of the parachute attached. The altitude of the airplane when dropping the equipment should be between 300 and 500 feet. To drop the equipment, the following steps should be observed.

c. Tie the loose end of the parachute static line to any solid metal structure of the airplane.

CAUTION

Do not attach static line to any part of one's body when throwing the equipment through the opening.

3. OPERATION—Complete operating instructions are contained in one of the bags which contain the equipment. Complete instructions for the use of transmitter are also located on the transmitter.

(3) RADIO OPERATOR'S POSITION

(a) GENERAL—TO OPERATE COMMUNICATIONS EQUIPMENT

1. *Plug head-set* into head-set disconnector cord (cord must be plugged into the interphone jack box (figure 80) PHONES jack). *Plug throat* microphone, or hand microphone, if installed, into microphone disconnecter cord jack (cord must be plugged into the interphone jack box "MIC" jack). (See figure 80).

2. Set the interphone jack-box (figure 80) selector switch on applicable position and turn INCREASE OUTPUT KNOB fully clockwise. If listening to radio sets having operating controls at other positions, head-set volume may be regulated with INCREASE OUT-PUT knob.

3. See paragraph *i* (2) *(b)* for operation of auxiliary power plant or external power.

(b) TO OPERATE INTERPHONE

1. Complete necessary operations included in (3) *(a)*, preceding.

2. Hold selector switch on the interphone jack box in the "CALL" position, call desired crew member and release selector switch, allowing it to return to "INTER".

3. When the crew member answers, intracommunication may be carried on with selector switch on "INTER".

(c) TO OPERATE COMMAND RADIO SET SCR-274-N

1. This radio set may be operated from this position only after operating adjustments have been made by the pilot.

2. Set the interphone jack box selector switch on the "COMMAND" position and receive and transmit by conventional use of the head set and the microphone.

(d) TO OPERATE RADIO COMPASS.—SCR-269-G. The radio compass may be operated by the radio operator or the copilot. At the radio operator's position there is a control box (figure 80) and an azimuth scale indicator (figure 80) which may be corrected for deviation and variation prior to obtaining a bearing. The instructions under paragraph *i,* (2), *(e)* apply to operation of the radio compass from the radio operator's position.

(e) TO OPERATE LIAISON RADIO SET—SCR-287-

1. GENERAL

a. Only those instructions necessary to enable crew members, other than the radio operator to operate this set in case of nonavailability of abbreviated instructions, referred to in the following paragraph, have been included herein. It is assumed that considerably more extensive knowledge of the use of the equipment, can be attained by the radio operator.

b. It is recommended that these instructions be supplemented by abbreviated instructions and a chart showing all transmitter and antenna loading unit dial and switch settings for each frequency normally used. Dial and switch settings listed should be applicable to a given installation in a given airplane and should be based upon flight operating tests. These abbreviated instructions should be available to crew members who may be required to operate the equipment.

2. RECEIVING COMPONENTS

a. RADIO RECEIVER, BC-348-( ).

(1) Plug in head set and microphone.

(2) Turn "OFF-AVC-MVC" switch on the liaison receiver (figure 80) to the "MVC" position.

(3) Turn the "CW-OSC" "ON-OFF" switch to "ON".

(4) Turn "BEAT FREQ" control so arrow on knob is pointing upward.

(5) Turn "CRYSTAL OUT-IN" switch to "OUT".

(6) Turn "DIAL LIGHTS" control clockwise.

(7) Turn "INCREASE VOL" control clockwise until a sufficiently strong background is heard.

(8) Turn "BAND SWITCH" to band covering 500 kilocycles, indicated on the frequency dial above the switch.

(9) Tune receiver to signal nearest to 500 kilocycles by means of the tuning crank.

(10) Tune the "ANT ALIGN" control for maximum signal indicated by head-set volume.

Note

In absence of signal the proper adjustment can be judged by the loudness of the background noise.

(11) To receive a modulated signal, turn "CW-OSC" switch to "OFF".

(12) Tune in desired signal by means of band change switch, tuning crank, and volume control.

(13) If a CW signal is being received, signal pitch may be adjusted by "BEAT FREQ" control.

(14) Automatic volume control may be employed after signal is tuned in by turning the "AVC-OFF-MVC" switch to "AVC".

(15) If noise and interfering signal reduction is desired, turn the "CRYSTAL OUT-IN" switch to the "IN" position and make any tuning adjustments necessary.

(16) Auxiliary head-set jacks marked "TEL" are provided on the face of the receiver.

(17) To turn off the receiver, turn the "AVC-OFF-MVC" switch to the "OFF" position.

3. TRANSMITTING COMPONENTS.

a. GENERAL

(1) The transmitter may be expected to give satisfactory service on "CW" as long as cabin altitude is less than 27,000 feet. On "TONE" and "VOICE", however, insulation break-down may be experienced with transmitter tuning unit TU-9-( ) (7700-10,000 kilocycles) above a cabin altitude of 19,000 feet. These altitude limitations may be exceeded slightly by care in tuning and by carefully guarding against accumulation of dust and other foreign matter in the equipment. Complete assurance of effective operation between 6200 and 10,000 kilocycles at cabin altitudes between 19,000 and 27,000 feet may be had on "CW" alone.

(2) Inasmuch as operation of the liaison transmitter on frequencies below 800 kilocycles involves tuning instruction for the antenna tuning unit figure (80), the tuning instructions for the transmitter are given under two sections, viz: for frequencies above 800 kilocycles and for frequencies below 800 kilocycles.

b. To operate liaison transmitter on frequencies above 800 kilocycles.

(1) Monitor the desired frequency on the receiver before effecting transmission.

(2) Insert the transmitter tuning unit covering the desired frequency in the transmitter.

(See Figure 80). Two tuning units (Figure 80) are mounted under the operator's table and four are mounted on the left side adjacent to the top turret in rear pressurized compartment.

(3) Set the "BAND CHANGE SWITCH" (A) on the position indicated on the "Calibration Chart" on the face of the tuning unit installed.

(4) Set the "M. O. TUNING" control (B) on the dial calibration (last two figures indicated on the vernier) corresonding to the desired frequency and the Calibration Chart. If the frequency falls between listed frequencies on Calibration Chart, see paragraph 3. f. for interpolation instructions.

(5) Set the "P. A. TUNING" control (C) on the dial calibration corresponding to the desired frequency and the Calibration Chart.

(6) Set the "ANT. COUPLING SWITCH" (D) on position "2".

(7) Set the "ANT. IND. TUNING" control (M) on "ZERO".

(8) Set the "ANT. CIRCUIT SWITCH" (N) on "2".

(9) Set the "ANT. CAP. TUNING" control (0) on "50".

(10) Set the "ANT. IND. SWITCH" (P) on "1".

(11) Set the variometer switch "E" on the antenna tuning unit (Figure 80) on position "1".

(12) Disconnect the antenna from the transmitter by throwing the antenna transfer switch (Figure 80) to an "OPEN" position.

(13) Set the "TONE-CW-VOICE" switch on "CW".

(14) Set the "CW FIL.-MOD. FIL." switch on "CW FIL."

(15) If the airplane is in flight, request pilot's permission to reel out antenna.

Note

The trailing antenna must be in before landing, when flying in formation, or when not in use.

(16) To reel out antenna, place trailing antenna fair-lead control lever (Figure 80) in "OUT" position and antenna transfer switch in trailing antenna position.

Note

If the trailing wire antenna control box (Figure 80) indicator does not read "000", adjust by means of the reset knob on left side of control box.

(17) Turn the "OFF-IN-OUT" switch on antenna reel control box to the "OUT" position and reel out an appropriate number of turns based upon the following table. One turn, indicated on the meter, equals approximately one foot.

RECOMMENDED ANTENNA LENGTHS:

Kilocycle	¼ Wave Lengths *(Feet)*	¾ Wave Lengths *(Feet)*
2000	123	
3000	82	
4000	62	
5000	49	147
6000	41	123
7000	35	105
8000	31	93
9000	27	81
10000	24	73

For frequencies below 800 kilocycles, use full length of trailing antenna.

(18) Turn the "ON-OFF" switch to "ON". Note filament voltage indicated on "FIL. VOLTAGE" meter. The pointer should fall on the red line. If not, remove the tube shield (upper front panel) and make sure the "24-28.5-VOLT" switch is in the appropriate position (if operating equipment from a battery cart as an external source of power, use the "24-VOLT position; if the auxiliary power plant, or external power plant, or the engines are running and delivering rated generator voltage output, use the "28.5-VOLT" position which is the normal terminal voltage of a battery under charge). Check to see that the "A-C—DC" switch in the tube compartment is in the "DC" position.

NOTE

Do not change tubes or make adjustments inside the transmitter with the test key, the microphone switch, or the hand key depressed. Do not operate any equipment with the tube shield removed.

(19) Press the "TEST KEY" on the face of the transmitter and tune the "P. A. TUNING" control "C" to obtain the minimum value of plate current, indicated on the "TOTAL PL. CURRENT" meter.

NOTE

If the minimum total plate current exceeds 100 milliamperes with the antenna circuit open, the transmitter should not be operated until the defect is corrected by maintenance personnel. Always release the "TEST KEY" while changing switch positions. When tuning, avoid pressing the test key any more than necessary.

(20) Place antenna transfer switch in trailing antenna position.

(21) Rotate "ANT. IND. TUNING" control "M" to obtain the maximum value of total plate current.

NOTE

Resonance will also be indicated in a secondary sense by the maximum value of antenna current indicated on the "ANT. CURRENT" meter. If no deflection of the plate current meter pointer is indicated or if the maximum plate current is less than 210-220 milliamperes, increase the "ANT. COUPLING SWITCH" "D" and repeat this tuning operation if necessary.

(22) It may be necessary to change the position of the "ANT. CAP. TUNING" control "O" or the length of the antenna and repeat operation (21) before a satisfactory plate loading of 210 to 220 milliamperes is obtained.

(23) The final tuning operation is to move "P. A. TUNING" control "C" to determine if a decrease in plate current, indicated on the total plate current meter, can be produced. If the movement of control "C" which produces the lowest value of plate current exceeds 2 to 3 dial divisions, or if the decrease in plate current exceeds 5 to 10 milliamperes, antenna coupling or antenna tuning adjustments are in error and operation *(19)* to *(23)* inclusive should be repeated.

(24) Transmit with the hand key. (See figure 80).

(25) To transmit tone or voice modulated signals, turn the "TONE-CW-VOICE" switch to the applicable position and transmit with the hand key or microphone.

(26) Each time the frequency is changed the transmitter must be returned accordingly, as outlined in the preceding paragraph.

c. TO OPERATE LIAISON TRANSMITTER ON FREQUENCIES BELOW 800 KILOCYCLES.

(1) Reel out all the trailing antenna wire and complete operations included in the preceding operating instructions for the laison transmitter, except that in operations *(6)* and *(8)* position "4" should be substituted for position "2".

(2) If it is impossible to resonate the antenna, set the "ANT. IND. SWITCH" "P" on positions "2", "3", "4", and "5" successively, attempting to resonate the antenna on each position by use of the "ANT. IND. TUNING" control "M".

(3) If operation *(2)* preceding, does nc permit resonating the antenna, set the "ANT. IND. TUNING" control "M" and the "ANT. IND. SWITCH" "P" on their maximum positions, set the antenna tuning unit selector switch "E" on positions "2", "3", "4", and "5" successively, and attempt to resonate the antenna by tuning with the "ANT. VARIOMETER" switch "F", on antenna tuning unit, on each position.

(4) Make sure in the preceding operations that sufficient antenna coupling is used and that the plate loading does not exceed 220 milliamperes.

(5) Transmission on "CW" may be effected by use of the hand key, or transmission of tone or voice modulated signals may be accomplished as heretofore noted.

(6) To turn off the transmitter turn the "ON-OFF" switch to "OFF".

Note

The maximum specified continuous running time for the transmitter dynamotor is 30 minutes. Always reel in the trailing antenna when communications are completed.

d. OPERATION OF LIAISON TRANSMITTER MONITOR SWITCH.

(1) The liaison monitor switch is located in the radio compass relay shield. This switch is used to enable the operator to quickly tune the transmitter to coincide with the frequency of any desired answering station.

(a) Roughly tune the transmitter to the desired frequency.

(b) Put the monitor switch in the "MONITOR" position.

(2) Listen to desired frequency on liaison receiver and adjust transmitter "M. O. TUNING" control until the transmitter sidetone beats against the desired station signal. The resulting "beat note" will indicate arrival at the proper setting of the transmitter "M. O. TUNING" control.

(3) Put the monitor switch in the "NORMAL" position for regular operation of the liaison transmitter.

a. It is *important* that the radio operator be able to tune to a given frequency quickly. Therefore the Calibration Chart on the front of the transmitter should be accurate. If a check with the frequency meter shows that the M. O. setting does not coincide with that of the Calibration Chart, check the calibration accuracy observing the following steps:

(1) Set transmitter tuning controls to positions appropriate for CW operation on 11,800 kilocycles.

CAUTION

M. O. control "B" must be set in accordance with the Calibration Chart and locked.

(2) Disconnect transmitter antenna.

(3) Place filament voltage switch in tube compartment in appropriate position.

(4) Place frequency meter in proximity of transmitter. (The frequency meter is located at aft end of forward pressurized compartment, on right side, lashed to the floor in a horizontal position. The unit is easily removed for use by unbuckling a single strap.

(5) Place frequency meter in operation and turn on transmitter by throwing "OFF-ON" switch to "ON". (Do not apply transmitter plate voltage).

(6) Tune transmitter with transmitter antenna disconnected.

(7) Set frequency meter on 11,800 kilocycles in accordance with the operating instructions and calibration chart furnished with the frequency meter.

(8) Open the calibration reset port located on the front panel between the TEST KEY and "TONE-CW-VOICE" switch, insert a screw driver and rotate the calibartion screw until the transmitter frequency coincides with that of the frequency meter. Obtain minimum PLATE CURRENT and adjust calibration if necessary until transmitter frequency is set with that of the frequency meter while the PLATE CURRENT meter reading is at minimum value.

(9) Close the calibration reset port. The transmitter is now properly calibrated for any of its tuning units.

(10) Tune transmitter as instructed.

f. To obtain dial settings for frequencies falling within the limits of those shown on the Calibration Chart, but not specifically shown thereon, interpolation of dial settings is necessary. (See figure 85).

(1) Desired operating frequency is 2589 kilocycles.

(2) Dial setting "B" (figure 85) for nearest listed higher frequency—2600 kilocycles—is 1289.

(3) Dial setting "B" (figure 85) for nearest listed lower frequency—2500 kilocycles—is 1035.

(4) Frequency and dial setting variation —100—254.

(5) Dial variation per kilocycle—2.54.

(6) Interpolation multiplier = 2589—2500 = 89.

(7) Interpolation product (dial units) = 2.54 x 89 = 226.

(8) Interpolated dial setting 1035 + 226 = 1261.

(9) Set "B" to 2589 by rotating units dial (figure 85) until a reading of 12 is obtained on the hundreds scale (figure 10) and a reading of 61 is obtained on units scale (figure 85).

(f) OPERATION OF FREQUENCY METER SET SCR-211-( )

1. GENERAL.

Inexperienced personnel should not attempt checking frequency of BC-375-( ) transmitter.

a. Secure an antenna, preferably a rigid wire not over two to three feet long, to the antenna terminal on top of the frequency meter cabinet. (Flexible insulated wire may be used).

b. Plug head set in the phones jack (figure 86); turn the power switch (figure 86) to "CRYSTAL" position. (Head-set extension cord must be plugged in to complete d-c power circuit to vacuum tubes). Allow vacuum tube filaments to warm for at least 10 minutes or longer, if necessary as indicated by the drifting of the beat note.

Note

Some frequency meters have a power "OFF-ON" switch and a "CRYSTAL "OFF-ON" switch.

c. From high or low frequency indices on front and rear covers of calibration book (figure 86) determine in which band desired frequency is located and set "FREQ BAND" selector switch (figure 86) to correspond.

d. Locate, in the calibration book, the heterodyne oscillator calibration for frequency desired. At bottom of the page will be found the crystal check point (in red) (figure 86), together with the heterodyne tuning dial setting (figure 86).

e. To set heterodyne tuning control to any desired crystal check point, rotate tuning control until the following readings are observed: (Using 5700 kilocycles as an example for this frequency, the crystal check point is 2070.5).

(1) The "DIAL HUNDREDS" scale (figure 86) should read "20".

(2) The "DIAL UNITS" scale (figure 86) should read "70".

(3) The fraction ".5" will be indicated when the fifth outer vernier marking (counterclockwise from the heterodyne control arrow) coincides with the fifth mark past 70 on the rotating inner scale (Figure 86). (There are 10 vernier markings, each representing one-tenth of a unit.) When the above readings are accomplished, lock the tuning dial.

f. A beat note will probably be heard, as complete absence of beat note can result only from three possible causes: that is, when heterodyne oscillator is exactly on calibration; when it is so far off calibration that beat frequency is above audibility; and when equipment is defective. First two conditions may be determined by rotating "CORRECTOR" dial to where beats become audible. If third condition is the cause, check battery voltages under load. (Filament voltage: 5.4 to 6.0, plate voltage 121.5 to 135.) Adjust heterodyne oscillator frequency by rotation of "CORRECTOR" dial (Figure 86) until a zero beat is reached.

2. TRANSMITTER ADJUSTMENTS.

a. The method of adjusting transmitter BC-375-(   ) to a frequency consists of zero-beating the transmitter frequency with the proper heterodyne oscillator frequency, effecting the comparison by means of a head set plugged into the "PHONES" jack on the front panel of the frequency meter. The "CRYSTAL" switch should be in the "CHECK" position during the process. ("OFF" position on meters having a crystal "OFF-ON" switch).

b. Specifically, the procedure for adjusting the BC-375-(   ) transmitter to a desired frequency is as follows:

(1) Correct the frequency meter heterodyne oscillator to calibration at the crystal check point nearest the desired frequency, as explained under *(f) 1,* e., preceding.

(2) Turn the "CRYSTAL" switch to "CHECK".

(3) Turn the frequency meter tuning control to the dial setting of the desired frequency, as given in the calibration book attached to the meter. Do not disturb the "CORRECTOR" control adjustment obtained in *(f) 1.* f., preceding.

(4) Disconnect the transmitter antenna.

(5) Obtain minimum reading on "TOTAL PLATE" current meter.

(6) Press "TEST KEY" on transmitter and vary "M. O." control "B" until a zero beat is heard in the frequency meter head set. Simultaneously obtain minimum dip on "TOTAL PLATE CURRENT" meter and zero-beat note on frequency meter. Lock M. O. control "B".

(7) Turn off frequency meter and remove head-set cord from plug jack.

(8) Connect transmitter antenna and resonate the antenna quickly to avoid unnecessary station interference.

3. RECEIVER ADJUSTMENTS.

a. The method of adjusting a receiver to a desired frequency consists of tuning the receiver to the proper heterodyne oscillator output frequency, and effecting the comparison by means of a pair of headphones connected to the receiver output circuit.

(1) Correct the heterodyne oscillator to calibration at the crystal check point nearest the desired frequency as explained under "OPERATION".

(2) Turn the "CRYSTAL" switch to "CHECK" and change over to another head set connected to the receiver output jack.

Note

If CD-196 or CD-307 extension cord is used in frequency meter, the head set may be disconnected and used in receiver position since the plug operates the power switch, the head set not being required.

(3) Turn the frequency meter tuning control to the dial setting of the desired frequency, as given in the calibration book and lock the dial. Do not disturb the "CORRECTOR" adjustment as made in paragraph 1.

(4) Adjust the receiver for "CW" reception as outlined in preceding operating instructions for the particular receiver to be checked.

(5) With the frequency meter antenna loosely coupled to the receiver antenna lead, vary the receiver tuning control in the vicinity of the desired frequency, listening for the output of the frequency meter. Signal source may be positively identified by tapping frequency meter antenna with finger and listening for resulting interruption.)

(6) Turn off frequency meter and remove head set from PHONE jack.

(g) OPERATION OF IFF RADIO SET SCR-695.

1. OPERATING COMPONENTS.

a. Turn on the local "ON-OFF" switch on the IFF control box. (See Figure 87.)

b. Set the selector switch on the control box to the numbered position designated by tactical orders.

c. If emergency operation is desired, place the "EMERGENCY" switch on the control box to the "ON" position.

d. To turn off the radio set, turn the local "ON-OFF" switch to the "OFF" position.

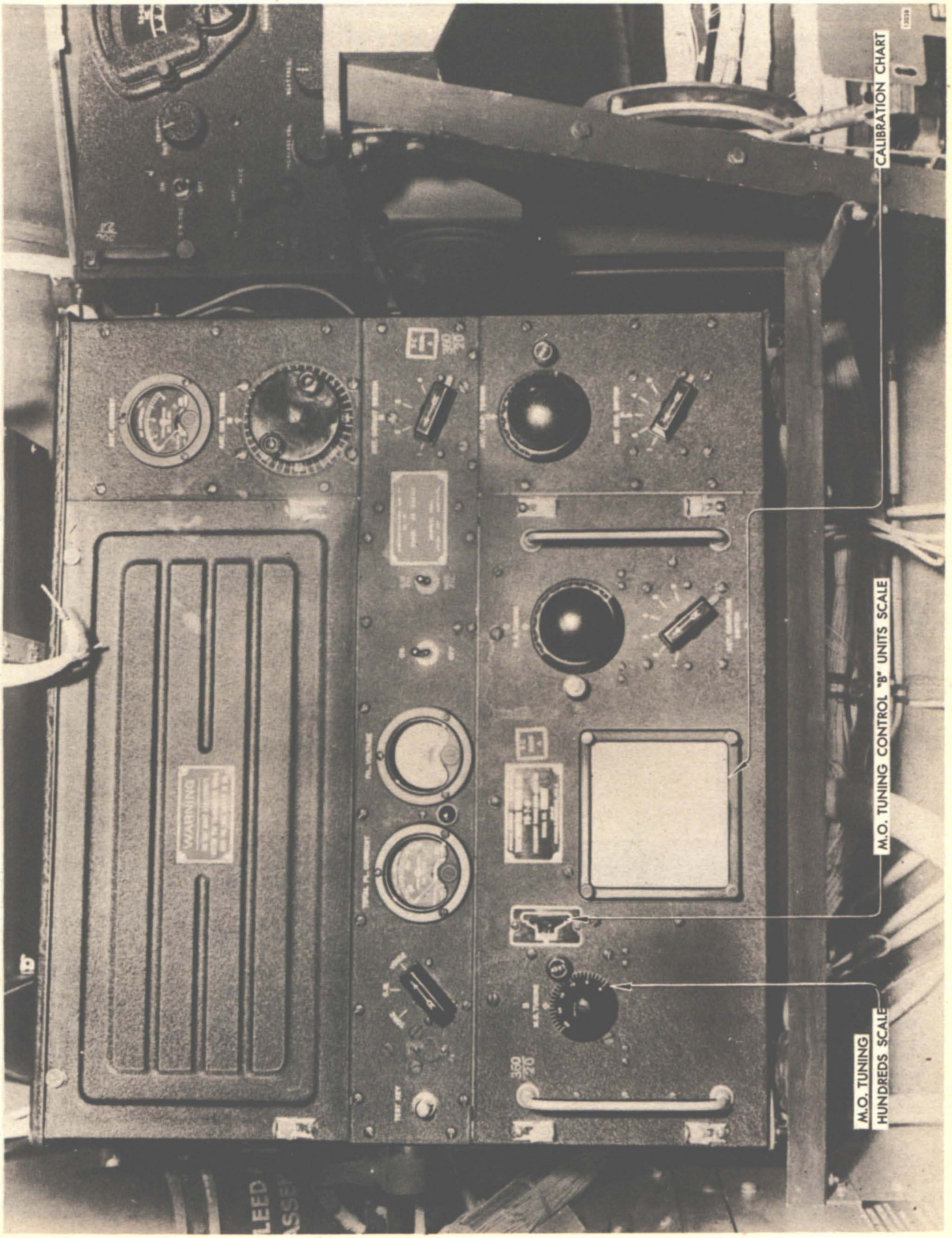


Figure 85 — Transmitter Tuning Unit TU-6

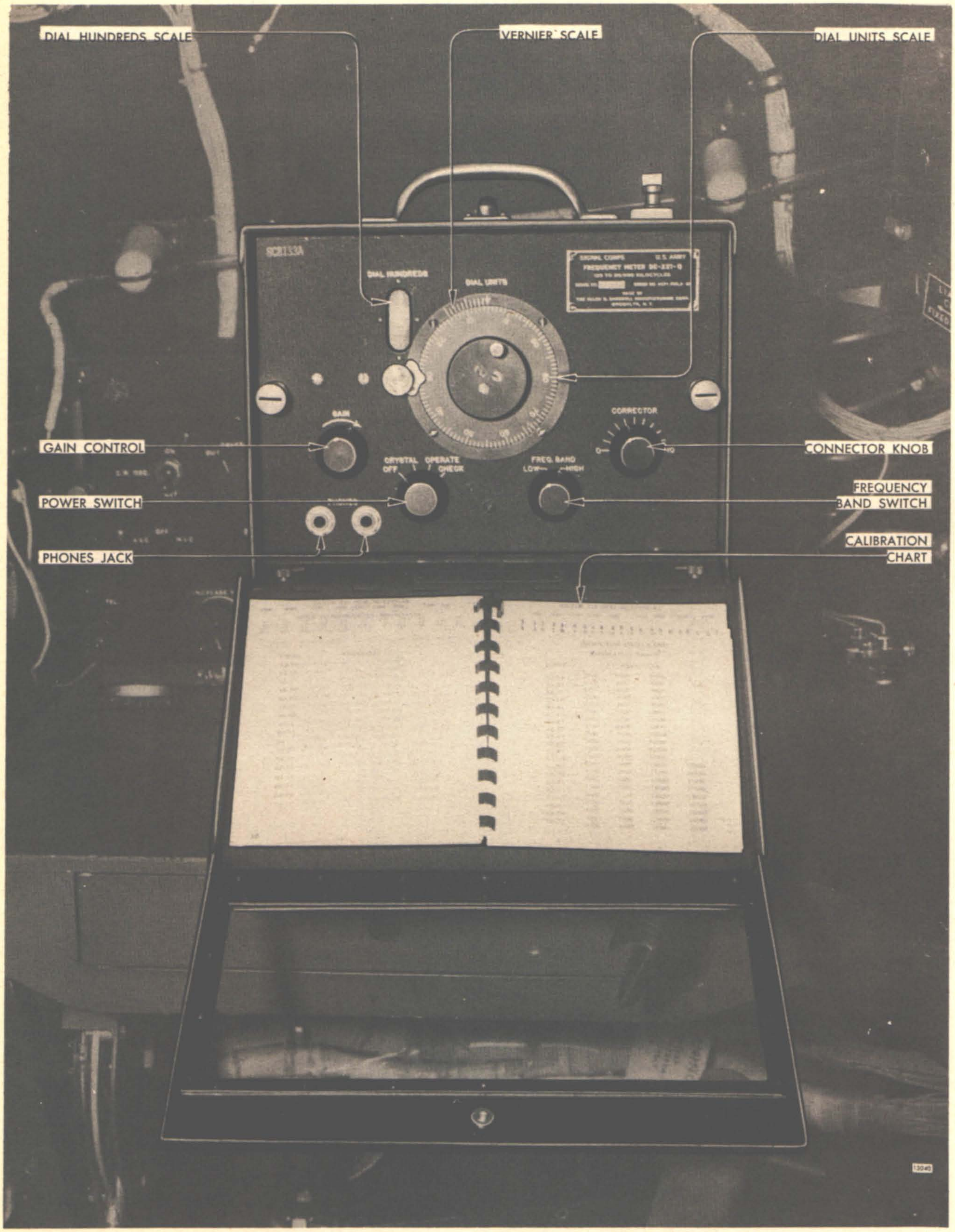


Figure 86 — Frequency Meter BC-221-B

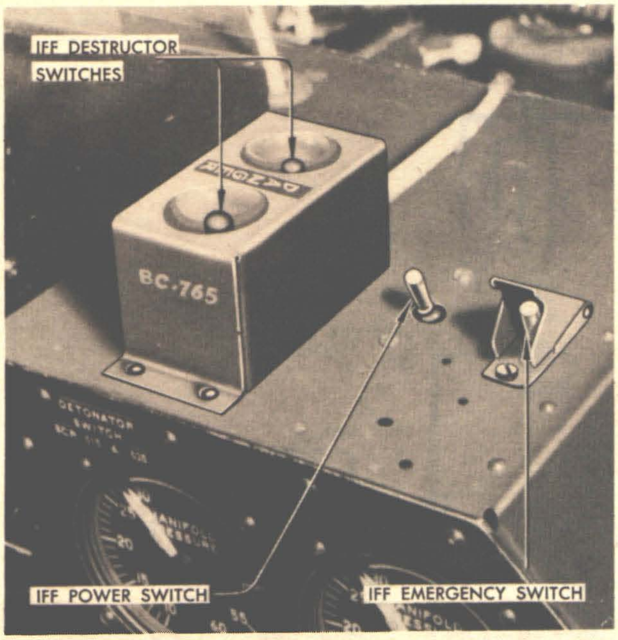


Figure 87 — IFF Control Switches Above Pilot's Instrument Panel

2. DESTRUCTOR COMPONENTS.

a. The switch controlling the destructor (detonator) unit installed in the IFF chasis is located at the pilot's and copilot's position.

b. To destroy the IFF radio set, if it becomes necessary to do so, raise the hinged cover of the destructor switch and simultaneously press the two switch buttons on the destructor switch.

4. ICE ELIMINATING EQUIPMENT.

a. PROPELLOR ANTI-ICER SYSTEM.—An anti-icing fluid may be pumped to a slinger ring at each propellor from where it is directed to the propellor leading edges. A toggle switch on the engineer's switch panel energizes two electric motor-driven pumps, which direct fluid to the slinger rings at the rate of 2 to 5 gallons per hour. The rate of flow may be controlled by two rheostats located on the lower right-hand side of the engineer's control stand; each rheostat controlling a pump.

b. WINDOW DEFROSTER SYSTEM.—The windows of the forward pressurized compartment are defrosted by warm air from the heating system. The defrosting system is controlled by the pilot and copilot. The pilot's control rod is on his left side near his left rudder pedal and controls window defrosting on the left side of the compartment plus the bombardier's window. The copilot's control rod is on his right side near his right rudder pedal and controls window defrosting on the right side. Two defroster blowers supply warm air to the three sighting domes in the rear pressurized compartment and controlled by means of a double pole toggle switch in the rear pressurized compartment fuse shield.

c. PITOT TUBE HEATERS.—The pitot tube heaters are located in the nose of the tube and are controlled by a relay actuated by a switch on the engineer's switch panel.

d. SURFACE DE-ICER SYSTEM.

(1) A conventional air inflation boot system is used to de-ice the leading edges of wings and empennage. Alternate pulses of vacuum and pressure are supplied from the engine-driven vacuum pumps through solenoid-operated distributing valves. The vacuum gage on the pilot's instrument panel has a normal indication of 4 to 6 inches Hg, while the deicing pressure gauge on the engineer's instrument panel has a normal indication of from 7 to 10 pounds per square inch.

(2) A toggle switch on the engineer's switch panel provides control over the de-icing system. Either inboard engine vacuum pump may be selected to provide vacuum for the instruments and de-icer boots, by means of a lever on the engineer's control stand.

(3) In the event of a boot rupture, the entire deicing system may be shut off by closing the emergency vacuum shut-off valve mounted on the navigator's filing cabinet. This does not affect proper functioning of the vacuum instruments.

(4) When the de-icer system is not in operation, vacuum pump suction prevents the negative air pressure from raising the de-icer boots.

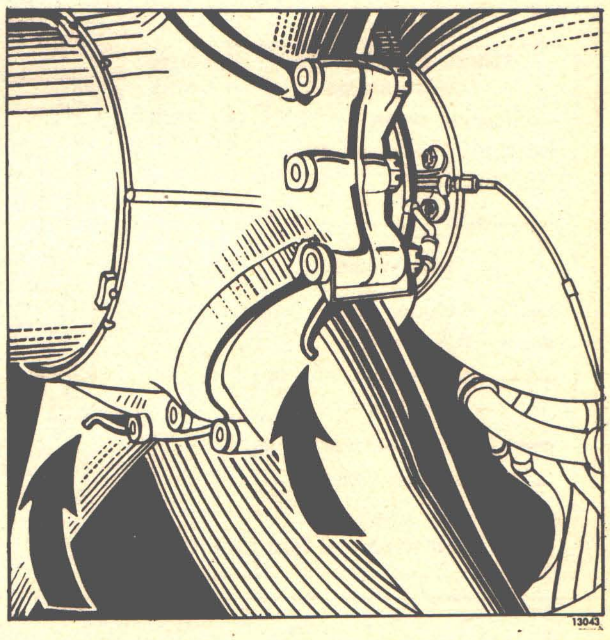


Figure 88 — Propeller Slinger Ring

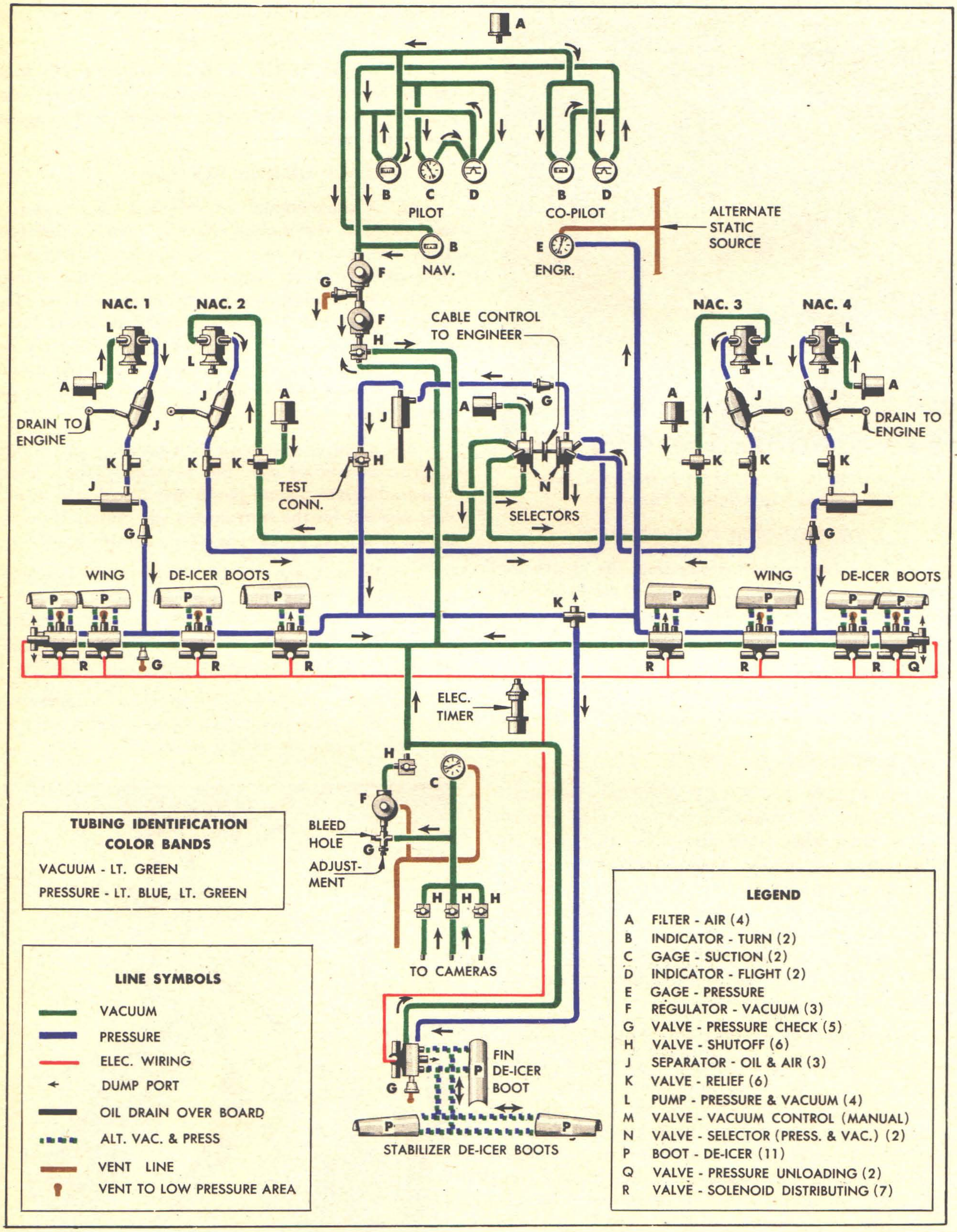


Figure 89 — Vacuum and De-Icer Flow Diagram

5. ARMAMENT.

a. GUNNERY EQUIPMENT

(1) GENERAL—Five remotely controlled power-operated gun turrets are provided in this airplane.

(a) UPPER REAR TURRET.

Location ....Station 728.
Armament ....Two .50-clbr. machine guns.
Lower limit of fire........Horizontal

(b) UPPER FORWARD TURRET.

Location ....Station 177.
Armament ....Two*.50-calbr. machine guns.
Lower limit of fire........5 degrees below horizontal.

(c) LOWER REAR TURRET.

Location ....Station 945.
Armament ....Two .50-calbr machine guns.
Upper limit of fire......5 degrees above horizontal.

(d) LOWER FORWARD TURRET.

Location ....Station 192.
Armament ....Two .50-calbr machine guns.
Upper limit of fire......5 degrees above horizontal.

(e) TAIL TURRET.

Location ....Extreme aft portion of the airplane.
Armament ....Two .50-caliber machine guns and one 20-mm cannon.

Rear limits of fire......30 degree angle above and below horizontal center line and 30 degrees right and left of vertical center line. Within these limits a pyrmid-shaped area of fire is formed.

*** Note**

Late B-29 airplanes mount a four gun upper forward turret.

(2) DESCRIPTION.

(a) UPPER TURRETS.—The upper turrets have provisions for ammunition boxes with a capacity of 1000 rounds per gun.

(b) LOWER TURRETS.—The lower turrets have provisions for ammunition boxes with a capacity of 1000 rounds per gun.

(c) TAIL TURRET.—The tail turret has provisions for ammunition boxes with a capacity of 1000 rounds for each of the two .50-caliber guns and 125 rounds for the 20-mm cannon.

(d) SIGHTS.

1. A pedestal type sight is provided at each of the following stations: bombardier's station, left-hand gunner's station, right-hand gunner's station and tail gunner's station. A sight on a ring mount is provided for the upper gunner.

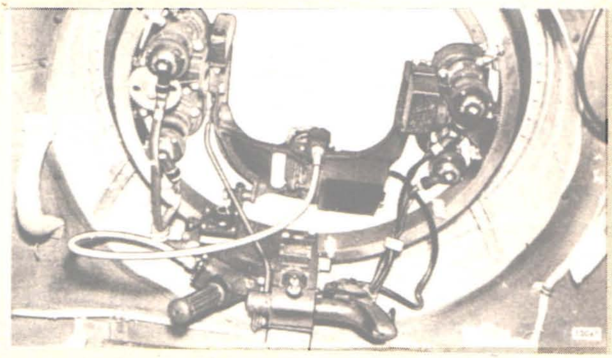


Figure 90 — Top Gunner's Sight

2. These sights control the horizontal and vertical movements of the turrets by means of electrical circuits. When the target is completely enclosed within a reflected circle of light, the guns are in range. The diameter of this circle is varied by adjusting the range finder control.

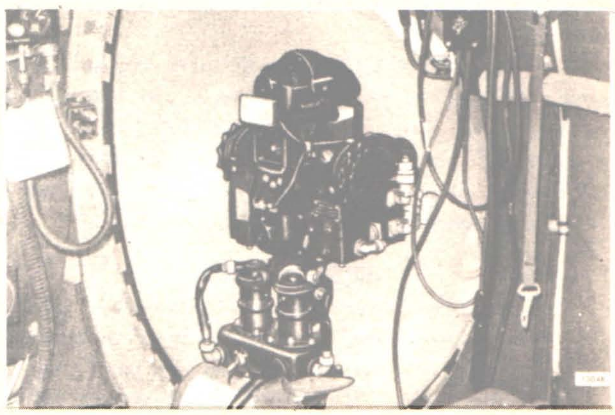


Figure 91 — Side Gunner's Sight

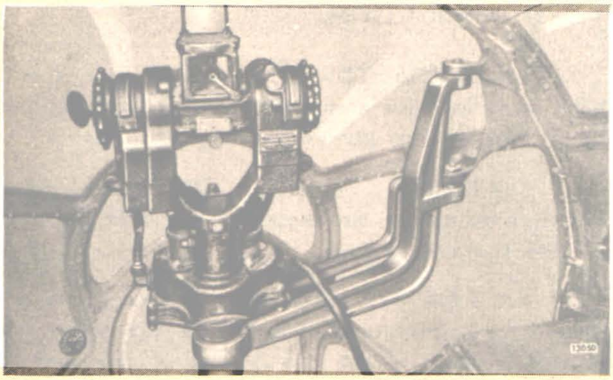


Figure 92 — Bombardier's Gun Sight

3. On the pedestal sights the gunner may position the sight by use of the control knobs. A thumb controlled trigger is found slightly above each of the two control knobs on each sight and all guns under control are fired simultaneously by either one or both of these triggers. An action switch at the left-hand control knob must be kept closed to retain control of the turrets being operated. The upper, or ringsight is controlled by a pair of handgrips; the left grip rotates for range control, while the right grip contains the action switch and the trigger. The sight and seat have unlimited azimuth travel.

4. All sights are stowed by means of the azimuth and elevation locks provided. Push in to lock, or pull out to release.

(e) CONTROL AND SWITCH BOXES.

1. TOP GUNNER.—Control over either or both of the upper turrets is provided for by a switch box located aft of the gun sight at station 706. Switches contained in this box turn on the power and operate the camera computer, and guns; however, primary control of the upper forward turret is by the bombardier's sight.

2. SIDE GUNNERS.— Through switches provided at their stations, the side gunners have primary control of the lower rear turret and secondary control of the lower front turret and tail turret. Only one sight can be in control of a given turret at any one time.

3. BOMBARDIER.—Primary control of the two forward turrets is afforded the bombardier through the front sighting station. No secondary control of other turrets is possible for this station. When not in use the bombardier's gun sight may be swung to one side of its hinged bracket.

WARNING

Guns of the lower forward turret must be facing aft during raising or lowering of the landing gear. Warning lights on the pilot's instrument panel illuminate if the turrets are not correctly positioned.

4. TAIL GUNNER.—Primary control of the tail turret is afforded at the tail gunner's sighting station but no secondary control of other turrets is possible from this station. Switches allow use of the cannon, machine guns and camera as desired.

(f) REPLENISHING AMMUNITION. — The upper, lower and tail turrets may be reloaded whenever the airplane is not pessurized, but the 20-mm gun, since it is reloaded from the outside, can only be serviced while on the ground.

(3) OPERATIONAL PROCEDURE.

(a) TRAVERSE.—Both upper and lower turrets have a horizontal traverse of 360 degrees and may be elevated to 90 degrees from horizontal. These turrets are equipped with cam-controlled cut-off switches which protect the airplane from its own fire. The tail turret is equipped with cut-off switches and mechanical stops which limits its vertical and horizontal movement to 30 degrees each side of centered position.

(b) CONTROL OF GUNS.—Control of a turret is accomplished by turning "ON" the turret power switches and depressing the action switch. The turret is then under the full control of the operator and may be positioned as desired.

(c) SEATING ARRANGEMENT.

1. The bombardier is seated at his regular station.

2. The tail gunner is seated just behind the armor plate pressure bulkhead door at station 1110.

3. The side gunners, one on the left and one on the right side of the airplane, sit facing aft, and have a 180-degree horizontal traverse with a converging angle of vision behind the airplane.

4. The top gunner sits on a swivel-type stool, the base of which contains slip rings to convey current from the power lines to the sight. The sight may be moved 60 degrees on the horizontal without swiveling the stool but further traverse of the sight without a corresponding rotation of the stool is prohibited by stops.

(b) ARMOR PLATE.—Protective armor plate is provided as follows: The pilot and copilot each have a panel behind their seats, and the radio operator and navigator are protected by panels installed on each side of the pressure bulkhead door on the aft side of bulkhead 218. There is a full bulkhead, including door, at station 706 to protect the two side gunners and upper gunner, and the computer mechanism is protected on the aft, right and left sides. The tail gunner is protected by an armor bulkhead at station 1144, bulletproof glass on three sides of his head, and armor plate in back of his head. Armor is also installed on three sides of the tail gunner's sighting mechanism.

"FIG. 93 HAS BEEN DELETED BY REVISION."

b. BOMBING EQUIPMENT.

(1) GENERAL.

(a) The two bomb bays are arranged as shown in Figure 4. The bomb doors may be opened at any altitude without affecting the pressurized areas.

(b) Entrance to the bomb bays during flight is through the pressure bulkhead doors. Exit from pressurized compartments thru bomb bays cannot be made until cabin pressure is released.

(c) On early airplanes the bomb doors are electrically actuated by mechanical controls. The "LOCK—SELECTIVE—SALVO" position of the bombs on early airplanes are selected by mechanical controls. On late airplanes all functions of the bomb control system are performed electrically. The bomb control system and the pneumatically actuated snap-action bomb doors are controlled by electrical switches.

(d) BOMB RACKS.—The bomb racks are attached to their supports by quick acting pins and are easily removed. Since they are not a structural part of the airplane, the airplane can be flown with the racks removed.

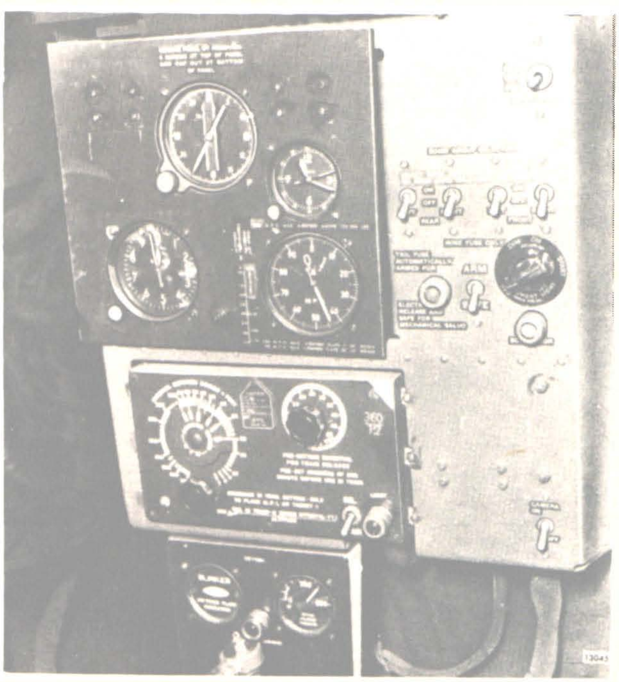


Figure 94—Bombardier's Control Panel—Early Airplanes.

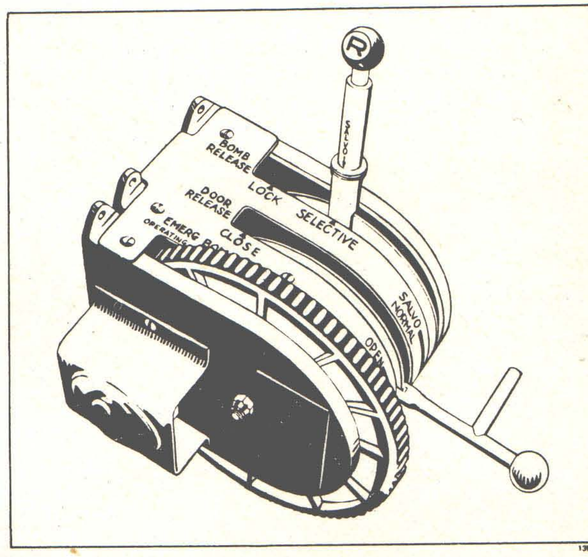


Figure 95—Bombardier's Control Stand—Early Airplanes.

(2) MECHANICAL—ELECTRICAL SYSTEM, EARLY AIRPLANES.

(a) GENERAL. — The bombardier's control panel is located on the left side of his compartment and is provided with controls, lights, and instruments as shown in Fig. 94. The bomb door control lever, the bomb release lever, and the emergency bomb release and rewind wheel are incorporated on a stand at the left of the bombardier's seat. The bomb door control lever controls the electric motors which actuate the doors. Refer to Section IV, paragraph 12, for emergency bomb release controls.

(b) BOMB RELEASE LEVER.—In the "LOCK" position of the bomb release lever, the bombs can not be released except by the emergency release and rewind wheel or either of the two emergency release handles. (See Section IV, paragraph 12). In the "SELECTIVE" position of the lever, the bomb racks are unlocked for electrical release of the bombs. The bomb release lever can not be moved to the "SALVO" position.

(c) BOMB RELEASE SWITCH. — The bomb release switch to the left of the bombardier's seat initiates the electrical release of bombs. A hinged guard provides protection against accidental release.

(3) ALL-ELECTRIC BOMB CONTROL SYSTEM, LATE AIRPLANES.—The all-electric bomb control system does away with the mechanical system used on early airplanes.

(a) The bombardier's control panel for the all-electric bomb system has instruments and controls as shown in Figure 96. The bomb release switch, on a flexible cord, is stowed in a clip on the side of the control panel.

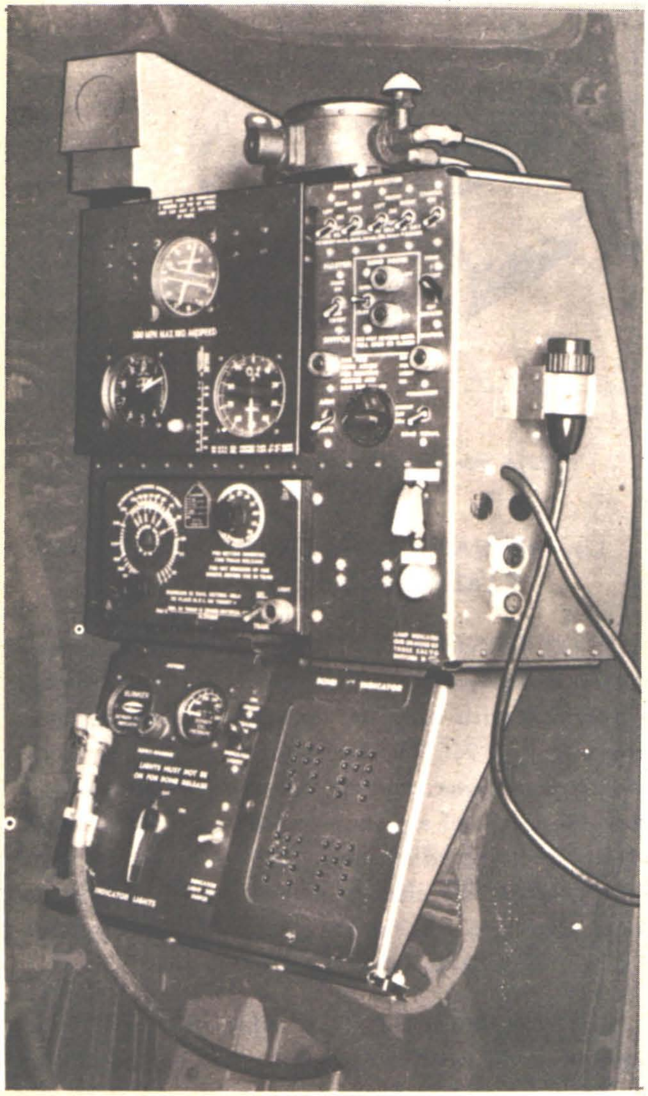


Figure 96—Bombardier's Control Panel —Late Airplanes

(b) All combinations for dropping bombs can be pre-selected by the positioning of indicators and switches on the control panel.

(c) The pneumatic snap action bomb bay doors are operated by moving the bomb door toggle switch to "OPEN" or "CLOSE" position as desired. The doors snap open immediately or snap closed immediately as the switch is operated.

(9) EMERGENCY RELEASE.

(d) In emergency the bombardier can salvo the bombs by operating the salvo switch on the control panel after turning the master switch "ON" or the pilot can salvo the bombs by operating the salvo switch on his aisle stand whether or not the master bomb circuit switch is "On". The salvo switches are covered by a hinged guard to prevent accidental tripping.

WARNING

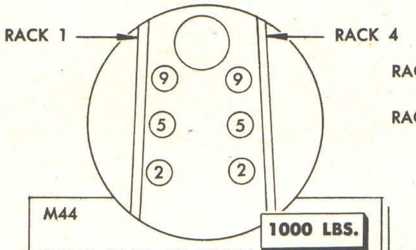
Never enter the bomb bay from outside the airplane without first checking that the bomb door safety switches are "OFF". The aft bomb door safety switch is mounted on the rear bulkhead alongside the bomb bay light. The forward bomb door safety switch is mounted on the forward bulkhead alongside the bomb bay light.

WARNING

After each flight and taxi, when the bomb doors are opened, a designated crew member in the crew's compartment and in the nose compartment will turn the bomb door safety switches to "OFF" before any crew member exits through the bomb bay. These switches remain in the "OFF" position at all times while the airplane is on the ground except during bomb door tests.

WARNING

Do not operate indicator switch when dropping bombs in normal release. (Bombs will drop salvo and unarmed.)

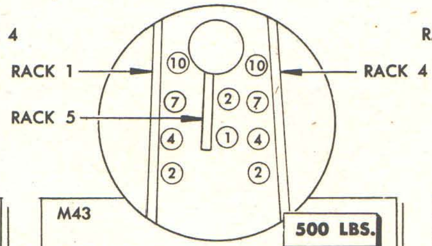


M44

1000 LBS.

TOTAL LOAD=12 BOMBS

RACK	STA.	GLIDE ANGLE	CLIMB ANGLE
FORWARD BOMB BAY — 6 BOMBS			
1 AND 4	2	59°	30 1/4°
1 AND 4	5	44°	15 3/4°
1 AND 4	9	33°	8 1/2°
REAR BOMB BAY — 6 BOMBS			
1 AND 4	2	59 1/4°	33 1/4°
1 AND 4	5	44 1/4°	16 1/2°
1 AND 4	9	33 1/2°	8 1/2°

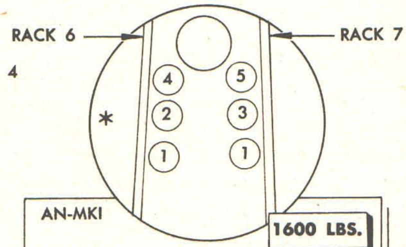


M43

500 LBS.

TOTAL LOAD=40 BOMBS

RACK	STA.	GLIDE ANGLE	CLIMB ANGLE
FORWARD BOMB BAY — 20 BOMBS			
FORWARD IN BAY			
1 AND 4	2	24 1/2°	17 1/4°
1 AND 4	4	10 3/4°	1°
1 AND 4	7	4 1/2°	17 1/4°
1 AND 4	10	1°	0°
5	1	11°	47 1/2°
5	2	6°	40 1/2°
AFT IN BAY			
1 AND 4	2	63 1/4°	19 3/4°
1 AND 4	4	53 1/2°	9 1/2°
1 AND 4	7	45°	4 3/4°
1 AND 4	10	37 1/2°	1/2°
5	1	17 1/4°	11 1/2°
5	2	1°	4°
REAR BOMB BAY — 20 BOMBS			
FORWARD IN BAY			
1 AND 4	2	24 1/2°	63°
1 AND 4	4	11 1/4°	53 1/4°
1 AND 4	7	5 1/4°	44 3/4°
1 AND 4	10	0°	37°
5	1	12°	17°
5	2	3 1/4°	1/2°
AFT IN BAY			
1 AND 4	2	17 1/4°	22 1/4°
1 AND 4	4	1°	9 3/4°
1 AND 4	7	17 1/4°	4°
1 AND 4	10	0°	1/2°
5	1	49°	11 1/4°
5	2	41 1/2°	5 1/4°

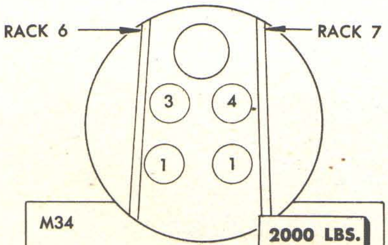


AN-MKI

1600 LBS.

TOTAL LOAD=12 BOMBS

RACK	STA.	GLIDE ANGLE	CLIMB ANGLE
FORWARD BOMB BAY — 6 BOMBS			
6 AND 7	1	46°	43 1/2°
6	2	26 1/2°	27°
7	3	26 1/4°	27°
6	4	17 1/4°	19 1/2°
7	5	17 1/4°	19 1/2°
REAR BOMB BAY — 6 BOMBS			
6 AND 7	1	47°	47 3/4°
6	2	26 1/4°	29°
7	3	26 1/4°	29°
6	4	17 1/4°	20 1/2°
7	5	17 1/4°	20 1/2°

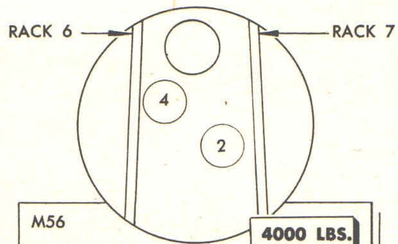


M34

2000 LBS.

TOTAL LOAD=8 BOMBS

RACK	STA.	GLIDE ANGLE	CLIMB ANGLE
FORWARD BOMB BAY — 4 BOMBS			
6 AND 7	1	42 1/4°	37°
6	3	20 1/2°	18 3/4°
7	4	20 1/2°	18 3/4°
REAR BOMB BAY — 4 BOMBS			
6 AND 7	1	43°	40°
6	3	21°	19 1/2°
7	4	21°	19 1/2°



M56

4000 LBS.

TOTAL BOMB LOAD=4 BOMBS

RACK	STA.	GLIDE ANGLE	CLIMB ANGLE
FORWARD BOMB BAY — 2 BOMBS			
6	4	4 3/4°	7 3/4°
7	2	21°	20 1/4°
REAR BOMB BAY — 2 BOMBS			
6	4	2 1/2°	7 1/4°
7	2	22°	22 1/4°

*FOUR STATIONS ONLY ON RACK 6

NOTES

FOR MAXIMUM ALLOWABLE AIR SPEED UNDER ALL CONDITIONS OF LOAD AND ALTITUDE SEE AIR SPEED INDICATOR. UNDER NO CONDITIONS SHALL THE MAXIMUM ALLOWABLE INDICATED AIR SPEED BE EXCEEDED.

ANGLES SHOWN ALLOW 10° FOR SAFETY. HOWEVER, UNDER PERFECTLY SMOOTH FLYING CONDITIONS IF IN THE AIRPLANE COMMANDER'S OPINION CONDITIONS WARRANT IT, THESE GIVEN ANGLES MAY BE EXCEEDED BY NOT MORE THAN 5°.

THE GLIDE OR CLIMB ANGLE IS THE ANGLE INCLUDED BETWEEN THE EARTH'S SURFACE AND FUSELAGE CENTERLINE.

13093

Figure 97 — Bomb Fixation Chart (Overload)

6. PHOTOGRAPHIC EQUIPMENT

a. In the aft unpressurized compartment near the auxiliary power plant, provision has been made for the vertical installation and operation of any one of the following cameras: A K-17, K-18, K-19 or K-23, K-21, K-24 or F-24. Also provision has been made for the oblique installation of two K-17 cameras located one on the right, and the other on the left-hand side of the airplane. A stowage bracket located on the right-hand side wall forward of the rear entrance door is provided for the K-20 portable camera, and during training operations a motion picture camera, type AN-N-4, is located in each of the five power turrets.

b. Camera openings are provided with skin flush doors which may be operated or removed while cabin is not pressurized. To exclude drafts from the camera compartment, canvas boots are provided which snap fasten to the fuselage and attach with draw strings to the vertical and oblique cameras.

c. The intervalometers, type B-2 or B-3, are mounted above the bombardier's instrument panel and are used in conjunction with the K-17, K-18, K-19, and F-24 cameras and may be pre-set to automatically operate the camera shutter, by electrical remote control, at specific intervals of time. Remote control of the turret cameras is provided at the individual turret sighting stations.

b. The K17, in its vertical mount, is used for rapid reconnaissance mapping and is equipped with a 6-, 12- and 24-inch lense cone; while in its oblique installation it is used for oblique spotting with the 6-inch lens cones. The K-18 camera is used for high altitude mosaic and spotting. The K-19, with an alternate installation of the K-23, is a night reconnaisance and spotting camera used in conjunction with a photo flash bomb, which may be released from a bomb rack by the bombardier. The camera shutter action occurs simultaneously with the explosion of the magnesium bomb. The K-24, with an alternate installation of the K-21, is used for orientation and the F-24 may be used for either day or night reconnaissance and spotting. The K-20 is a portable camera with which photographs may be taken from windows and doors in the airplane, as desired.

e. The master shut-off valve for the camera vacuum on the camera panel, station 834, isolates the camera vacuum system from the main system. It is a two-position manually operated valve.

CAUTION

This shut-off valve must be open at all times to supply vacuum to the de-icers. Otherwise, there is danger that the de-icers may flutter due to the air flow over the leading edges.

f. The individual shut-off valves for the camera vacuum located on the camera panel, shuts off vacuum in each of the three individual camera vacuum lines. The three valves are two-position, manually operated valves.

8. MISCELLANEOUS EQUIPMENT

a. SEATS.—(Refer to Seat Adjustment Diagram, Figure 99).

(1) The pilot's and copilot's seats are both provided with vertical, horizontal, and reclining adjustments; while the bombardier's seat back only may be adjusted. The engineer's seat is not provided with adjustments. The radio operator's and navigator's chairs are the "posture" type and are fixed to the floor; the navigator's chair being on slides and movable parallel with the airplane's center line.

(2) The side gunner's positions are built in the structure and cannot be adjusted. The top gunner is provided a stool mounted on a pedestal which may be completely rotated to aid in following a target with high sight. The tail gunner's seat is held up above the gunner's entrance door by springs when not in use, and may be pulled down upon entry to the compartment.

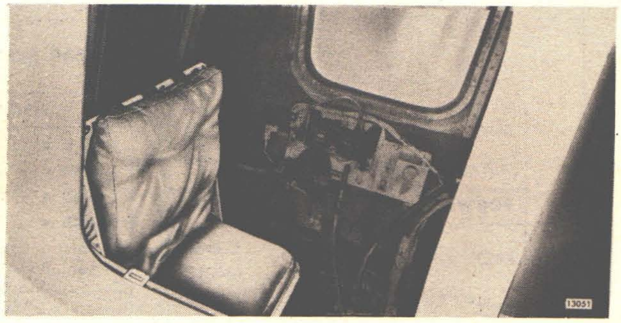


Figure 98 — Tail Gunner's Seat

b. BUNKS.—Four bunks are provided in the rear pressurized compartment aft of the armor plate bulkhead, two of which may be used as seats for additional crew members by stowing the top bunks against the side wall of the fuselage. Planes equipped with radar have only two bunks.

c. SAFETY BELTS.—Each normal and alternate crew member is provided with a safety belt.

d. LAVATORY EQUIPMENT.—A chemical toilet is provided in the central left portion of the rear pressurized compartment, and a relief tube is located on the navigator's cabinet in the forward compartment.

e THERMOS JUGS.—Two thermos jugs are supplied; one located on the top of the navigator's cabinet, and the other mounted on the rear compartment auxiliary panel. Paper cup dispensers are provided adjacent to each jug.

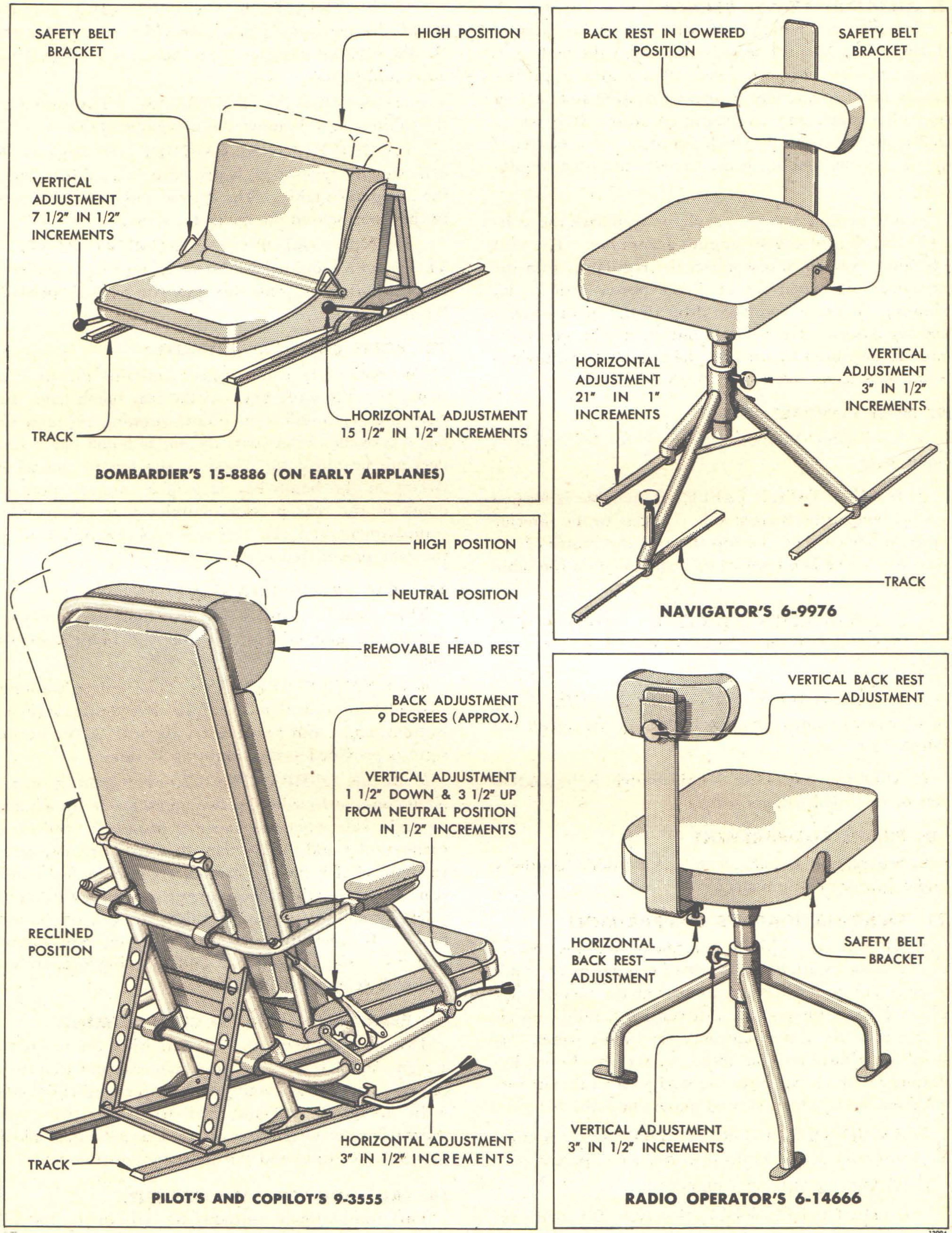


Figure 99 — Seat Adjustment Diagram

8. AUXILIARY POWER PLANT.

The auxiliary power unit, which must be running during every take-off and landing, is in the body, opposite the rear entrance door. The engine is permanently installed and has its own air cooling system, fuel and oil supply, and automatic controls. It drives a 200 ampere generator which supplied extra electrical power for the landing gear, starters, and other equipment.

a. A generator voltage regulator equalizes the voltage with that of the six-engine generators. The unit contains a switch to disconnect the regulator from the equalizer bus when the auxiliary power unit is not running, to prevent voltage drop in the main generator regulators. The voltage output of the generator may be measured by turning the engineer's voltmeter-ammeter selector switch to "AUX PP."

9. NOSE COMPARTMENT

a. See Section V, Paragraph 5, *b,* for bombardier's equipment.

b. BOMBARDIER'S TABLE.—This table is located on the bombardier's right side. Access to the interior is gained by sliding the top towards the center of the airplane. The bombing chart is mounted on the table top.

e. BOMBARDIER'S CONTROL PANEL. — This panel is located on the sidewall to the left of the bombardier.

d. BOMBARDIER'S CONTROL STAND. — The bombardier's control stand is located to the left of the bombardier's seat.

e. RELEASE SWITCH.—This switch is located to left of the bombardier's seat.

10. PILOT'S COMPARTMENT

a. See Section I, Paragraph 1, for pilot's, copilot's, and engineer's equipment.

11. RADIO-NAVIGATOR'S COMPARTMENT

a. GENERAL.—This compartment contains the radio operator's station, right side of compartment; navigator's station, left side of compartment; forward upper and lower turrets; life raft control handles; on either side of the tunnel entrance; hydraulic panel, forward of pressurized bulkhead, under the floor; hydraulic supply tank, above the navigator's cabinet; forward entrance ladder, stowed under the step.

b. RADIO OPERATOR STATION.—See Section V, Paragraph 3, for radio operator's equipment.

c. NAVIGATOR'S STATION.

(1) DRIFT RECORDER.—A type B-5 drift recorder is mounted to sight through a plastic blister on the side.

(2) NAVIGATOR'S CABINET.—This cabinet, aft of the navigator's table, provides storage for the G files, celestial navigation kit, octant, and miscellaneous equipment.

(3) NAVIGATOR'S MAP CASE.—This case is on the cabin side wall above the navigator's table.

(4) DRIFT SIGNAL CABINET.—Stowage for 20 drift signals, type M-25, is provided in a cabinet under the navigator's table. The drift signal chute is located in the floor behind the navigator's seat.

(5) NAVIGATOR'S INSTRUMENT PANEL.—This panel is mounted on the navigator's table and contains an altimeter, gyro flux gate compass, airspeed indicator and clock.

12. BOMB BAY COMPARTMENT

The bomb bay compartment contains the forward bomb bay, the wing bay and the rear bomb bay. Besides the communication tunnel running through the bay a catwalk circumvents the entire bomb bay. Ladders are provided for access to the top of the wing. Access to the bomb bay is gained through pressure doors in the rear pressure bulkhead or the forward compartment and the forward pressure bulkhead of the rear pressurized compartment.

13. REAR PRESSURIZED COMPARTMENT.

This compartment is divided into two compartments, the gunner's station and the bunk compartment.

a. GUNNER'S STATION.—This station contains two side fire control and an upper fire control sighting stations, and cabin pressure regulators. A computing sight is provided at each sighting station.

b. BUNK COMPARTMENT.—The bunk compartment contains four bunks, two on each side; two bunks on right side when the radar is installed; upper rear turret; toilet and relief tubes, forward left side; cabin vacuum relief valve and camera vacuum control panel, rear aft side; auxiliary equipment panel, forward right side; nacelle platform and ladder stowed on bottom bunk, left side; engine covers, mooring case, engine tool kit, wing jacking pad and mooring eye, stowed under the compartment floor.

14. REAR UNPRESSURIZED COMPARTMENT.

This compartment contains provision for installing a right and left hand oblique camera, and a vertical camera; starter crank and gear box, forward right sidewall; storage battery and auxiliary power plant, forward left side; lower rear turret; rear entrance ladder, stowed on ceiling, and tail gun ammunition cans.

15. TAIL GUNNERS COMPARTMENT.

This compartment contains the tail turret and tail gunner's station, foot rests are installed on the ammunition tubes for the gunner.

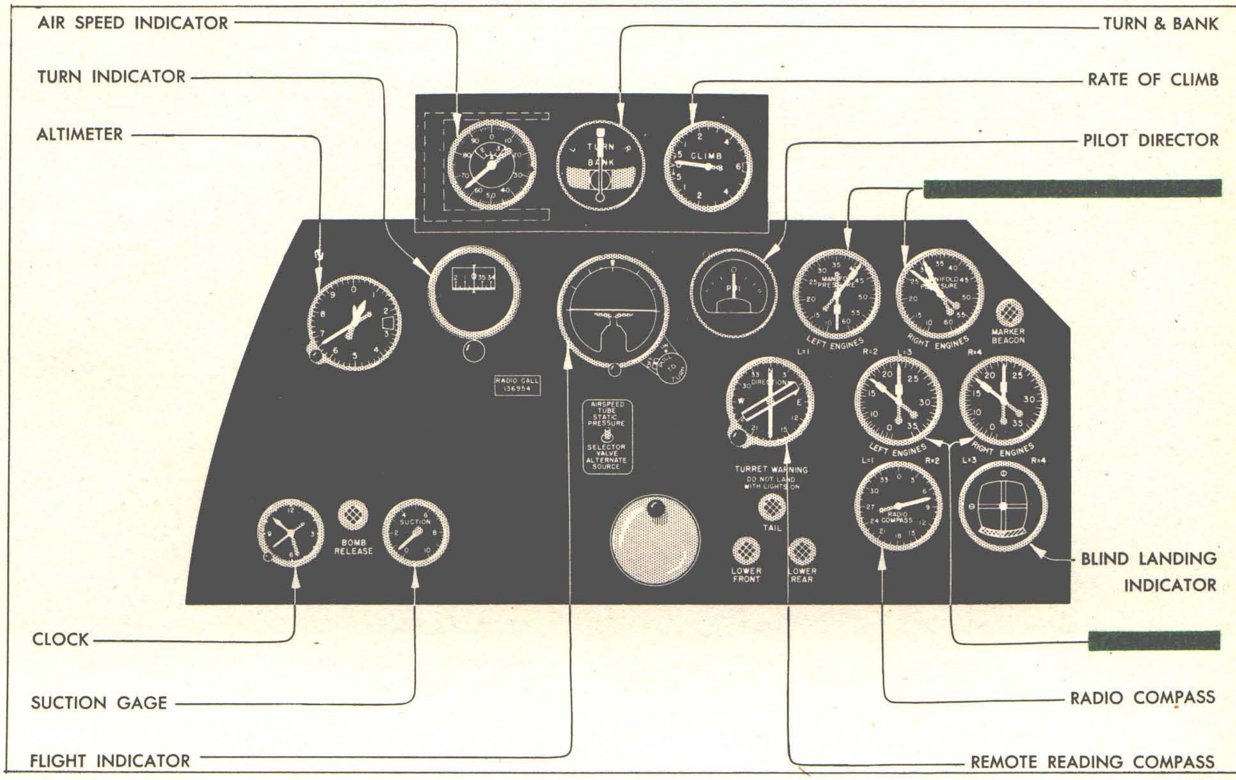


Figure 100 — Pilot's Instrument Panel (EARLY MODELS)

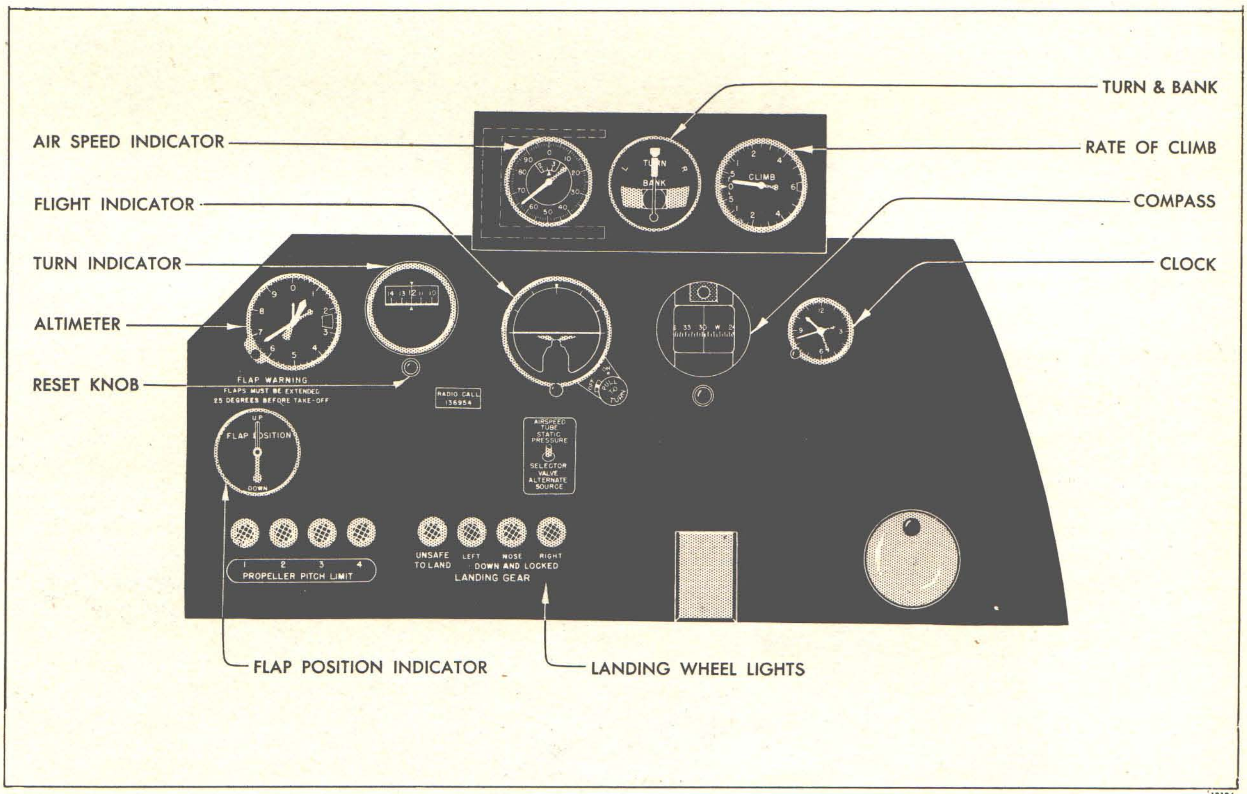


Figure 101 — Copilot's Instrument Panel (EARLY MODELS)

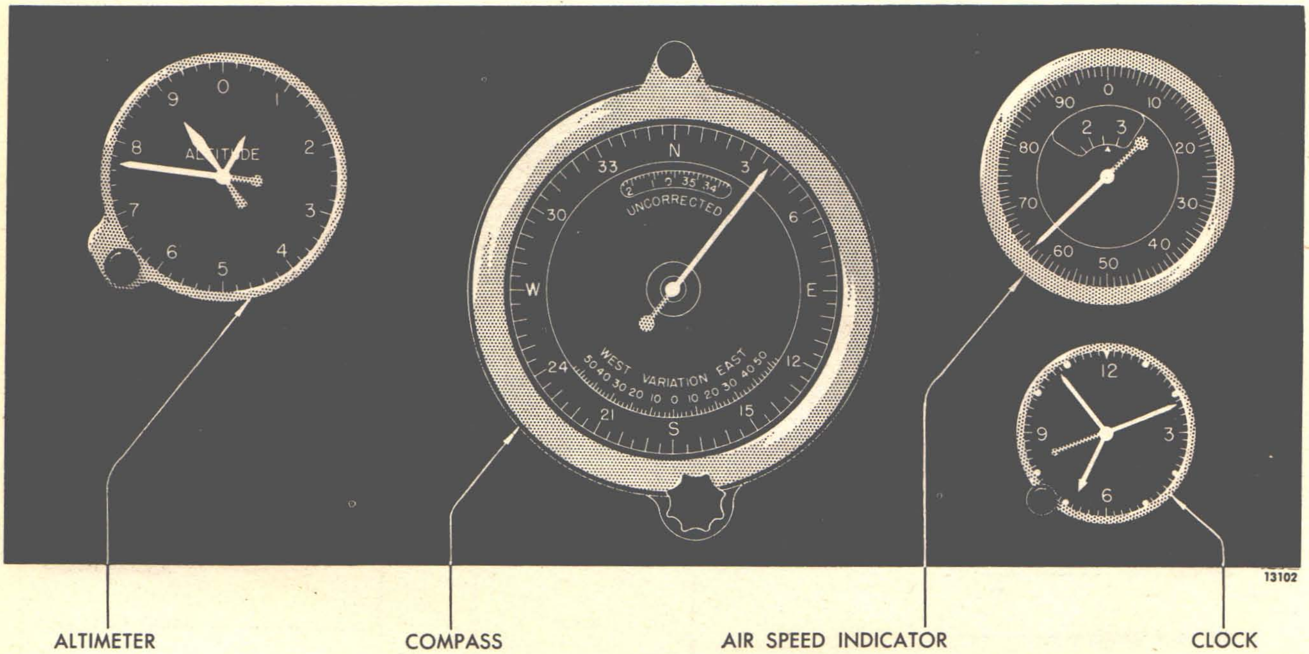


Figure 102 — Navigator's Instrument Panel

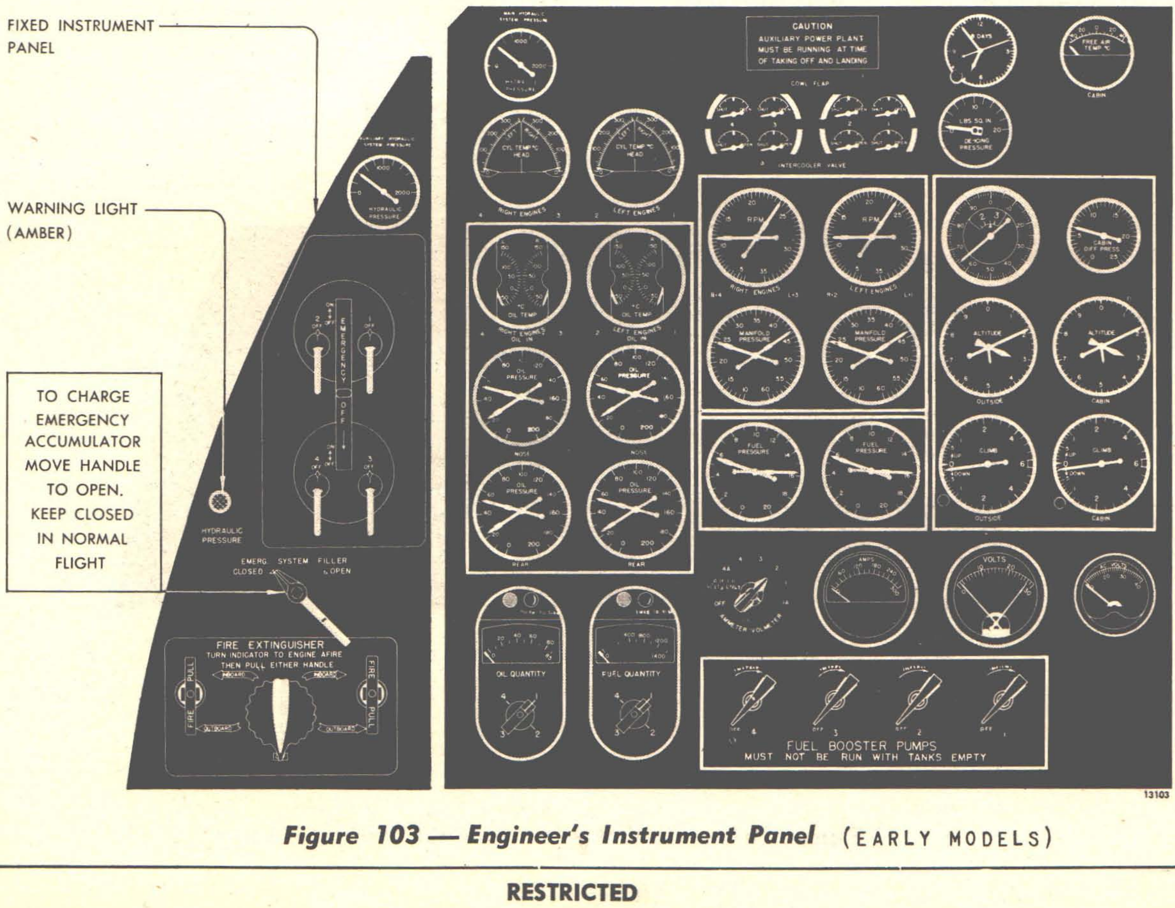


Figure 103 — Engineer's Instrument Panel (EARLY MODELS)

APPENDIX I

U. S. A. - BRITISH GLOSSARY OF NOMENCLATURE

U. S. A.	BRITISH
Accumulator (hydraulic)	Should not be confused with electrical accumulator or battery
Airfield	Aerodrome
Battery (electrical)	Electrical accumulator
Bombardier	Bomb aimer
Ceiling	Cloud height
Check valve (hydraulic)	Non-return valve
Copilot	Second pilot
Cylinder (hydraulic)	Jack
Empennage	Tail unit
Flight indicator	Artificial horizon
Gasoline (gas)	Petrol
Glass, bulletproof	Armour glass
Gross weight	All-up weight
Ground (electrical)	Earth
Gyro horizon	Artificial horizon
Gyro pilot	Automatic pilot
(to) Land	(to) Alight
Lean	Weak
Left	Port
(to) Level off	(to) Flatten out
Line, mooring	Mooring guy
Manifold pressure	Boost
Mast, radio	Rod aerial
Overload	Non-standard load
Panel, outboard	Outer plane
Reticle (gun sight)	Graticule
Screen	Filter
Set, command	Pilot controller set
Set, liaison	General purpose set
Airplane	Aircraft
Speed, indicated air (IAS)	Air-speed-indicator reading
Stabilizer, horizontal	Tail plane
Stabilizer, vertical	Fin
Stack	Manifold (inlet or exhaust)
Tachometer	Engine speed indicator
Tube (radio)	Valve
Turn indicator	Direction indicator
Valve (fuel or oil)	Cock
Weight empty	Tare
Windshield	Windscreen
Wing	Main plane

APPENDIX II

FLIGHT INFORMATION INSTRUCTION CHARTS

WF-3-31-44-10M
AAFMC-527
4-1-44

AIRCRAFT MODEL(S) B-29, B-29A

TAKE-OFF, CLIMB & LANDING CHART

ENGINE MODEL(S) R-3350-13, 21, 23, 23A

TAKE-OFF DISTANCE FEET

GROSS WEIGHT LB.	HEAD WIND		HARD SURFACE RUNWAY						SOD-TURF RUNWAY						SOFT SURFACE RUNWAY					
			AT SEA LEVEL		AT 3000 FEET		AT 6000 FEET		AT SEA LEVEL		AT 3000 FEET		AT 6000 FEET		AT SEA LEVEL		AT 3000 FEET		AT 6000 FEET	
	M.P.H.	KTS.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.
HEAVY WEIGHT 130,000 LB.	0		4250	6250	4775	7100	5400	8000	5200	7200	5775	8100	6750	9350	7750	9750	8400	11000	11400	14000
	20		3125	4925	3525	5600	4050	6250	3800	5600	4325	6400	5200	7400	5800	7600	6300	8500	9000	11200
	40		2275	3750	2575	4325	2900	4750	2825	4300	3050	4800	3850	5700	4275	5750	4550	6400	6750	8600
AVERAGE WEIGHT 110,000 LB.	0		2725	4000	3075	4525	3500	5100	3200	4475	3600	5050	4300	5900	4375	5650	4900	6500	6200	7800
	20		2100	3125	2350	3575	2750	4050	2475	3500	2775	4000	3300	4600	3400	4425	3750	5050	4850	6150
	40		1525	2350	1775	2750	1950	3000	1775	2600	2050	3000	2450	3500	2525	3350	2800	3850	3550	4600
LIGHT WEIGHT 90,000 LB.	0		1750	2575	1975	2900	2225	3300	1975	2800	2275	3200	2525	3600	2500	3325	2725	3800	3325	4400
	20		1400	2000	1550	2300	1675	2500	1560	2150	1700	2450	1975	2800	1950	2550	2125	2950	2575	3400
	40		1075	1550	1200	1750	1325	1950	1175	1650	1350	1900	1475	4100	1425	1900	1575	2200	1925	2550

NOTE: INCREASE CHART DISTANCES AS FOLLOWS: 75°F + 10%; 100°F + 20%; 125°F + 30%; 150°F + 40% OPTIMUM TAKE-OFF IS 80% OF CHART VALUES
DATA AS OF 7-1-44 BASED ON: ESTIMATES

CLIMB DATA

GROSS WEIGHT LB.	AT SEA LEVEL				AT 5000 FEET					AT 10,000 FEET					AT 15,000 FEET					AT 25,000 FEET					AT 30,000 FEET				
	BEST I.A.S.		RATE OF CLIMB F.P.M.	GAL. OF FUEL USED	BEST I.A.S.		RATE OF CLIMB F.P.M.	FROM SEA LEVEL		BEST I.A.S.		RATE OF CLIMB F.P.M.	FROM SEA LEVEL		BEST I.A.S.		RATE OF CLIMB F.P.M.	FROM SEA LEVEL		BEST I.A.S.		RATE OF CLIMB F.P.M.	FROM SEA LEVEL		BEST I.A.S.		RATE OF CLIMB F.P.M.	FROM SEA LEVEL	
	MPH	KTS			MPH	KTS		TIME MIN.	FUEL USED	MPH	KTS		TIME MIN.	FUEL USED	MPH	KTS		TIME MIN.	FUEL USED	MPH	KTS		TIME MIN.	FUEL USED	MPH	KTS		TIME MIN.	FUEL USED
HEAVY WEIGHT 130,000 LBS.	195		560	157	195		510	10	310	195		450	20	483	195		380	32	683	195		180	68	1285	195		20	126	2040
AVERAGE WEIGHT 110,000 LBS.	195		850	157	195		800	6	255	195		740	13	368	195		670	20	484	195		480	37	776	195		340	49	965
LIGHT WEIGHT 90,000 LBS.	195		1230	157	195		1160	4	226	195		1090	9	352	195		1010	14	378	195		820	25	562	195		700	31	676

POWER PLANT SETTINGS: (DETAILS ON FIG. 49 SECTION III): 2400 RPM & 43.5 IN. HG. AUTO RICH
DATA AS OF 7-1-44 BASED ON: ESTIMATES
FUEL FLOWS ARE 5% CONSERVATIVE
FUEL USED (U.S. GAL.) INCLUDES WARM-UP & TAKE-OFF ALLOWANCE

LANDING DISTANCE FEET

GROSS WEIGHT LB.	BEST IAS APPROACH				HARD DRY SURFACE						FIRM DRY SOD						WET OR SLIPPERY					
	POWER OFF		POWER ON		AT SEA LEVEL		AT 3000 FEET		AT 6000 FEET		AT SEA LEVEL		AT 3000 FEET		AT 6000 FEET		AT SEA LEVEL		AT 3000 FEET		AT 6000 FEET	
	MPH	KTS	MPH	KTS	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.
LIGHT WEIGHT 90,000 LB.	125		125		2370	3150	2580	3450	2820	3750	2640	3420	2880	3750	3150	4080	6120	6900	6690	7560	7320	8250

DATA AS OF 7-1-44 BASED ON: ESTIMATES OPTIMUM LANDING IS 80% OF CHART VALUES

REMARKS:

NOTE: TO DETERMINE FUEL CONSUMPTION IN BRITISH IMPERIAL GALLONS, MULTIPLY BY 10, THEN DIVIDE BY 12

LEGEND
I.A.S. : INDICATED AIRSPEED
M.P.H. : MILES PER HOUR
KTS. : KNOTS
F.P.M. : FEET PER MINUTE

Figure 104 — Take-off, Climb and Landing Chart

AAFMC-528
4-1-44

AIRCRAFT MODEL(S)
B-29

ENGINE(S): R-3350-13, -21, -23 & 23A

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: 140,000 TO 130,000 POUNDS

EXTERNAL LOAD ITEMS
NONE

NUMBER OF ENGINES OPERATING: 4

LIMITS	R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.	FOR DETAILS SEE POWER PLANT CHART (FIG. SECT. III)
WAR EMERG.								
MILITARY POWER	2600	47.5	--	A.R.	5	260°	1130	

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN **FUEL** COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING(1) MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT **RANGE** VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE **(ALT.)** READ RPM, MANIFOLD PRESSURE **(M.P.)** AND **MIXTURE** SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON **(MI./GAL.)** (NO WIND), GALLONS PER HR. **(G.P.H.)** AND TRUE AIRSPEED **(T.A.S.)** ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).(1) TO OBTAIN **BRITISH IMPERIAL GAL. (OR G.P.H.)**: MULTIPLY **U.S. GAL. (OR G.P.H.)** BY **10** THEN DIVIDE BY **12.**

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES (3)		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
		10250	SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (1)						10250		
3140	2720	10000	3400	2950	4100	3560			10000		
2980	2580	9500	3230	2800	3900	3380			9500	REFER	TO
2820	2450	9000	3060	2660	3690	3200			9000	MAXIMUM	RANGE
2660	2310	8500	2890	2500	3480	3020			8500	CONTROL	CURVE
2510	2170	8000	2720	2360	3280	2840			8000		
2350	2040	7500	2550	2210	3070	2670			7500		
2190	1900	7000	2380	2060	2870	2490			7000		
2040	1770	6500	2210	1920	2660	2310			6500		
1880	1630	6000	2040	1770	2460	2140			6000		
1720	1500	5500	1870	1620	2260	1960			5500		
1570	1360	5000	1700	1480	2050	1780			5000		

PRESS ALT. FEET	MAXIMUM CONTINUOUS R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT.(2) G.P.H.	T.A.S. M.P.H.	T.A.S. KTS.
40000						
35000						
30000						
25000	--	--	--	--	--	--
20000	2400	43.5	A.R.	995	312	
15000	2400	43.5	A.R.	995	301	
10000	2400	43.5	A.R.	989	294	
5000	2400	43.5	A.R.	970	280	
S.L.	2400	43.5	A.R.	938	266	

PRESS ALT. FEET	(.34 STAT. (NAUT.) MI./GAL.) R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT.(2) G.P.H.	T.A.S. M.P.H.	T.A.S. KTS.	(.41 STAT. (NAUT.) MI./GAL.) R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT.(2) G.P.H.	T.A.S. M.P.H.	T.A.S. KTS.
40000												
35000												
30000												
25000	--	---	--	--	--	--						
20000	2300	39	A.R.	846	288							
15000	2300	39	A.R.	826	281		--	--	--	--	--	--
10000	2300	39	A.R.	818	278		2200	35	A.R.	612	251	
5000	2300	38	A.R.	767	261		2200	35	A.R.	586	240	
S.L.	2300	38	A.R.	738	251		2200	35	A.R.	558	229	

PRESS ALT. FEET	(STAT. (NAUT.) MI./GAL.) R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT.(2) G.P.H.	T.A.S. M.P.H.	T.A.S. KTS.	MAXIMUM AIR RANGE R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT. G.P.H.	T.A.S. M.P.H.	T.A.S. KTS.
40000												
35000												
30000									SEE NOTE			
25000									ABOVE			
20000												
15000												
10000												
5000												
S.L.												

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG.) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.
(2) FUEL FLOWS (G.P.H.) ARE 5% CONSERVATIVE.
(3) RANGE IS BASED ON FUEL MILEAGE TAKEN AT 20,000 FT. ALT. ONLY.

EXAMPLE

AT 140,000 LB. GROSS WEIGHT WITH 8000 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF GAL.) TO FLY 3000 STAT. AIRMILES AT 5000 FT. ALTITUDE MAINTAIN 2200 RPM AND 35 IN. MANIFOLD PRESSURE WITH MIXTURE SET: A.R.

LEGEND

ALT.	PRESSURE ALTITUDE	F.R.	FULL RICH
M.P.	MANIFOLD PRESSURE	A.R.	AUTO-RICH
GPH	U.S. GAL. PER HOUR	A.L.	AUTO-LEAN
TAS	TRUE AIRSPEED	C.L.	CRUISING LEAN
KTS.	KNOTS	M.L.	MANUAL LEAN
S.L.	SEA LEVEL	F.T.	FULL THROTTLE

DATA AS OF 7-1-44 BASED ON: ESTIMATES

RED FIGURES ARE PRELIMINARY. DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure 105 — Flight Operation Instruction Chart (Sheet 1 of 6 Sheets)

AAFMC-528
4-1-44

AIRCRAFT MODEL(S)	FLIGHT OPERATION INSTRUCTION CHART	EXTERNAL LOAD ITEMS
B-29		NONE
ENGINE(S): R-3350-13, -21, -23 & -23A	CHART WEIGHT LIMITS: 130,000 TO 120,000 POUNDS	NUMBER OF ENGINES OPERATING: 4

LIMITS	R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.
WAR EMERG.							
MILITARY POWER	2600	47.5		A.R.	5	260°	1130

FOR DETAILS SEE POWER PLANT CHART (FIG. SECT. III)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING(1) MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).(1) TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES (3)		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
			SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (1)								
2540	2200	8000	2800	2430	3440	2990			8000		
2380	2060	7500	2620	2280	3220	2800			7500		
2220	1930	7000	2440	2130	3000	2610			7000	REFER TO MAXIMUM RANGE CONTROL CURVE	
2060	1790	6500	2280	1980	2790	2420			6500		
1900	1650	6000	2100	1820	2580	2240			6000		
1740	1510	5500	1920	1670	2360	2050			5500		
1590	1380	5000	1750	1520	2150	1860			5000		
1430	1240	4500	1570	1370	1930	1680			4500		
1270	1100	4000	1400	1220	1720	1490			4000		
1110	965	3500	1220	1060	1500	1310			3500		
950	825	3000	1050	910	1290	1120			3000		

MAXIMUM CONTINUOUS						PRESS	(.35 STAT. (NAUT.) MI./GAL.)						(.43 STAT. (NAUT.) MI./GAL.)						(STAT. (NAUT.) MI./GAL.)						PRESS	MAXIMUM AIR RANGE					
R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT.(2) G.P.H.	T.A.S. M.P.H.	T.A.S. KTS.	ALT. FEET	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT.(2) G.P.H.	T.A.S. M.P.H.	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT.(2) G.P.H.	T.A.S. M.P.H.	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. M.P.H.	T.A.S. KTS.	ALT. FEET	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. M.P.H.	T.A.S. KTS.
						40000																			40000						
						35000																			35000						
--	--	--	--	--	--	30000																			30000		SEE NOTE ABOVE				
2400	43.5	A.R.	985	324		25000	--	--	--	--	--	--													25000						
2400	43.5	A.R.	995	316		20000	2300	39	A.R.	856	300		--	--	--	--	--	--							20000						
2400	43.5	A.R.	995	305		15000	2300	39	A.R.	820	287		2200	35	A.R.	607	261								15000						
2400	43.5	A.R.	989	298		10000	2300	39	A.R.	809	283		2200	35	A.R.	610	262								10000						
2400	43.5	A.R.	970	283		5000	2300	38	A.R.	760	266		2200	35	A.R.	576	248								5000						
2400	43.5	A.R.	938	269		S.L.	2300	38	A.R.	724	253		2200	35	A.R.	545	234								S.L.						

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG.) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

(2) FUEL FLOWS ARE 5% CONSERVATIVE

(3) NOTE: RANGE IS BASED ON FUEL MILEAGE TAKEN AT 20,000 FT.

EXAMPLE

AT 130,000 LB. GROSS WEIGHT WITH 8000 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF GAL.) TO FLY 3300 STAT. AIRMILES AT 15000 FT. ALTITUDE MAINTAIN 2200 RPM AND 35.0 IN. MANIFOLD PRESSURE WITH MIXTURE SET: A.R.

LEGEND

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
F.R. : FULL RICH
A.R. : AUTO-RICH
A.L. : AUTO-LEAN
C.L. : CRUISING LEAN
M.L. : MANUAL LEAN
F.T. : FULL THROTTLE

DATA AS OF 7-1-44 BASED ON: ESTIMATES

RED FIGURES ARE PRELIMINARY. DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure 105 — Flight Operation Instruction Chart (Sheet 2 of 6 Sheets)

AAFMC-528
4-1-44

WF-8-31-44-10M

AIRCRAFT MODEL(S) B-29	FLIGHT OPERATION INSTRUCTION CHART	EXTERNAL LOAD ITEMS NONE
ENGINE(S): R-3350-13, -21, -23 & -23A	CHART WEIGHT LIMITS: 120,000 TO 110,000 POUNDS	NUMBER OF ENGINES OPERATING: 4

LIMITS	R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.
WAR EMERG.							
MILITARY POWER	2600	47.5		A.R.	5	260°	1130

FOR DETAILS SEE POWER PLANT CHART (FIG. SECT. III)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING[1] MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND)[1]. TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES (3)		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
			SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING[1]								
2120	1840	6500	2400	2080	3640	3160			6500		
1960	1700	6000	2220	1920	3360	2920			6000	REFER	TO
1790	1560	5500	2040	1760	3080	2670			5500	MAXIMUM	RANGE
1630	1420	5000	1850	1600	2800	2430			5000	CONTROL	CURVE
1470	1270	4500	1670	1440	2540	2180			4500		
1300	1130	4000	1480	1280	2240	1940			4000		
1140	990	3500	1290	1120	1960	1700			3500		
980	850	3000	1110	960	1680	1450			3000		
810	710	2500	920	800	1400	1210			2500		
650	560	2000	740	640	1120	970			2000		
490	420	1500	550	480	840	730			1500		

MAXIMUM CONTINUOUS						PRESS ALT. FEET	(.37 STAT. (NAUT.) MI./GAL.)						(.56 STAT. (NAUT.) MI./GAL.)					
R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT.[2] G.P.H.	T.A.S. M.P.H.	T.A.S. KTS.		R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT.[2] G.P.H.	T.A.S. M.P.H.	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT.[2] G.P.H.	T.A.S. M.P.H.	T.A.S. KTS.
						40000												
						35000												
--	--	--	--	--	--	30000	--	--	--	--	--	--						
2400	43.5	A.R.	985	322		25000	2300	39	A.R.	834	308							
2400	43.5	A.R.	995	323		20000	2300	39	A.R.	834	308							
2400	43.5	A.R.	995	309		15000	2300	38	A.R.	790	292		--	--	--	--	--	--
2400	43.5	A.R.	989	302		10000	2300	38	A.R.	765	283		2100	31	A.L.	428	240	
2400	43.5	A.R.	970	286		5000	2250	37	A.R.	721	267		2100	31	A.L.	406	228	
2400	43.5	A.R.	938	272		S.L.	2250	37	A.R.	686	254		2100	31	A.L.	884	215	

(STAT. (NAUT.) MI./GAL.)						PRESS ALT. FEET	MAXIMUM AIR RANGE					
R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT.[2] G.P.H.	T.A.S. M.P.H.	T.A.S. KTS.		R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT. G.P.H.	T.A.S. M.P.H.	T.A.S. KTS.
						40000						
						35000						
						30000		SEE NOTE ABOVE				
						25000						
						20000						
						15000						
						10000						
						5000						
						S.L.						

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG. PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.
(2) FUEL FLOWS (G.P.H.) ARE 5% CONSERVATIVE.
(3) RANGE IS BASED ON FUEL MILEAGE TAKEN AT 25,000 FT. ALT. ONLY.

EXAMPLE

AT 120,000 LB. GROSS WEIGHT WITH 4,000 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF GAL.) TO FLY 1480 STAT. AIRMILES AT 15000 FT. ALTITUDE MAINTAIN 2300 RPM AND 38 IN. MANIFOLD PRESSURE WITH MIXTURE SET: A.R.

LEGEND

ALT. :	PRESSURE ALTITUDE	F.R. :	FULL RICH
M.P. :	MANIFOLD PRESSURE	A.R. :	AUTO-RICH
GPH :	U.S.GAL. PER HOUR	A.L. :	AUTO-LEAN
TAS :	TRUE AIRSPEED	C.L. :	CRUISING LEAN
KTS. :	KNOTS	M.L. :	MANUAL LEAN
S.L. :	SEA LEVEL	F.T. :	FULL THROTTLE

DATA AS OF 7-1-44 BASED ON: ESTIMATES

RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure 105 — Flight Operation Instruction Chart (Sheet 3 of 6 Sheets)

AAFMC-528
4-1-44

AIRCRAFT MODEL(S)	FLIGHT OPERATION INSTRUCTION CHART	EXTERNAL LOAD ITEMS
B-29		NONE
ENGINE(S): R-3350-13, -21, -23 & -23A	CHART WEIGHT LIMITS: 110,000 TO 100,000 POUNDS	NUMBER OF ENGINES OPERATING: 4

LIMITS	R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.
WAR EMERG.							
MILITARY POWER	2600	47.5		A.R.	5	260°	1130

FOR DETAILS SEE POWER PLANT CHART (FIG. SECT. III)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING[1] MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND)[1]. TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES (3)		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
			SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING[1]								
1670	1450	5000	1900	1650	2250	1950	2850	2470	5000		
1500	1300	4500	1710	1480	2020	1750	2560	2220	4500	REFER	TO
1330	1160	4000	1520	1320	1800	1560	2280	1980	4000	MAXIMUM RANGE	
1170	1010	3500	1330	1150	1570	1360	1990	1730	3500	CONTROL CURVE	
1000	870	3000	1140	990	1350	1170	1710	1480	3000		
830	720	2500	950	820	1120	970	1420	1230	2500		
660	580	2000	760	660	900	780	1140	990	2000		
500	430	1500	570	590	670	580	850	740	1500		
330	290	1000	380	330	450	390	570	490	1000		
160	140	500	190	160	220	190	280	240	500		

MAXIMUM CONTINUOUS						PRESS	(.38 STAT. (NAUT.) MI./GAL.)					
R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT.[2] G.P.H.	T.A.S. M.P.H.	T.A.S. KTS.	ALT. FEET	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT.[2] G.P.H.	T.A.S. M.P.H.	T.A.S. KTS.
						40000						
--	--	--	--	--	--	35000	--	--	--	--	--	--
2400	43.5	A.R.	969	343		30000	2300	39	A.R.	865	329	
2400	43.5	A.R.	985	329		25000	2300	39	A.R.	831	316	
2400	43.5	A.R.	995	327		20000	2300	39	A.R.	824	313	
2400	43.5	A.R.	995	316		15000	2300	38	A.R.	776	295	
2400	43.5	A.R.	989	303		10000	2300	38	A.R.	755	287	
2400	43.5	A.R.	970	288		5000	2250	37	A.R.	705	268	
2400	43.5	A.R.	938	274		S.L.	2250	37	A.R.	676	257	

PRESS	(.45 STAT. (NAUT.) MI./GAL.)						(.57 STAT. (NAUT.) MI./GAL.)						MAXIMUM AIR RANGE					
ALT. FEET	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT.[2] G.P.H.	T.A.S. M.P.H.	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT.[2] G.P.H.	T.A.S. M.P.H.	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	T.A.S. M.P.H.	T.A.S. KTS.
40000																		
35000																		
30000	--	--	--	--	--	--												
25000	2200	35	A.R.	651	293		--	--	--	--	--	--		SEE NOTE ABOVE				
20000	2200	35	A.R.	653	294		2100	31	A.L.	468	267							
15000	2200	35	A.R.	620	279		2100	31	A.L.	446	255							
10000	2200	34	A.R.	600	270		2100	31	A.L.	436	249							
5000	2200	34	A.R.	555	250		2100	31	A.L.	412	235							
S.L.	2200	34	A.R.	526	237		2100	31	A.L.	386	220							

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG.) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.
(2) FUEL FLOW (G.P.H.) ARE 5% CONSERVATIVE.
(3) RANGE IS BASED ON A FUEL MILEAGE AT 25,000 FT. ALT. ONLY.

EXAMPLE

AT 110,000 LB. GROSS WEIGHT WITH 3,000 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF GAL.) TO FLY 1650 STAT. AIRMILES AT 15,000 FT. ALTITUDE MAINTAIN 2100 RPM AND 31 IN. MANIFOLD PRESSURE WITH MIXTURE SET: A.L.

LEGEND

ALT.	PRESSURE ALTITUDE	F.R.	FULL RICH
M.P.	MANIFOLD PRESSURE	A.R.	AUTO-RICH
GPH	U.S.GAL. PER HOUR	A.L.	AUTO-LEAN
TAS	TRUE AIRSPEED	C.L.	CRUISING LEAN
KTS.	KNOTS	M.L.	MANUAL LEAN
S.L.	SEA LEVEL	F.T.	FULL THROTTLE

DATA AS OF 7-1-44 BASED ON: ESTIMATES

RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure 105 — Flight Operation Instruction Chart (Sheet 4 of 6 Sheets)

AAFMC-528 4-1-44	AIRCRAFT MODEL(S) B-29 ENGINE(S): R3350-13, -21, -23, -23A	FLIGHT OPERATION INSTRUCTION CHART CHART WEIGHT LIMITS: 100,000 TO 90,000 POUNDS	EXTERNAL LOAD ITEMS NONE NUMBER OF ENGINES OPERATING: 4

LIMITS	R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.	FOR DETAILS SEE POWER PLANT CHART (FIG. SECT. III)
WAR EMERG.								
MILITARY POWER	2600	47.5		A.R.	5	260°	1130	

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING[1] MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).[1] TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES (3)		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
			SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING[1]								
1190	1030	3500	1540	1330	2060	1790	2300	2000	3500		
1020	880	3000	1320	1140	1770	1530	1980	1720	3000	REFER TO	
850	740	2500	1100	950	1470	1280	1650	1430	2500	MAXIMUM RANGE	
680	590	2000	880	760	1180	1020	1320	1140	2000	CONTROL CURVE	
510	440	1500	660	570	880	760	990	860	1500		
340	290	1000	440	380	590	510	660	570	1000		
170	140	500	220	190	290	250	330	280	500		

MAXIMUM CONTINUOUS						PRESS ALT. FEET	(.44 STAT. (NAUT.) MI./GAL.)					
R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT.[2] G.P.H.	APPROX. T.A.S. M.P.H.	APPROX. T.A.S. KTS.		R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT.[2] G.P.H.	APPROX. T.A.S. M.P.H.	APPROX. T.A.S. KTS.
						40000						
--	--	--	--	--	--	35000	--	--	--	--	--	--
2400	43.5	A.R.	969	350		30000	2250	37	A.R.	714	314	
2400	43.5	A.R.	985	335		25000	2250	36	A.R.	689	303	
2400	43.5	A.R.	995	331		20000	2250	36	A.R.	681	300	
2400	43.5	A.R.	995	315		15000	2200	35	A.R.	648	285	
2400	43.5	A.R.	989	307		10000	2200	35	A.R.	625	275	
2400	43.5	A.R.	970	291		5000	2200	35	A.R.	586	258	
2400	43.5	A.R.	938	277		S.L.	2200	35	A.R.	556	245	

(.59 STAT. (NAUT.) MI./GAL.)						(.66 STAT. (NAUT.) MI./GAL.)						PRESS ALT. FEET	MAXIMUM AIR RANGE					
R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT.[2] G.P.H.	APPROX. T.A.S. M.P.H.	APPROX. T.A.S. KTS.	R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT.[2] G.P.H.	APPROX. T.A.S. M.P.H.	APPROX. T.A.S. KTS.		R.P.M.	M.P. INCHES	MIXTURE	APPROX. TOT. G.P.H.	APPROX. T.A.S. M.P.H.	APPROX. T.A.S. KTS.
												40000						
												35000						
												30000		SEE NOTE ABOVE				
--	--	--	--	--	--							25000						
2100	31	A.L.	470	277								20000						
2100	31	A.L.	448	264		--	--	--	--	--	--	15000						
2100	31	A.L.	433	255		1900	28	A.L.	346	228		10000						
2100	31	A.L.	405	239		1800	28	A.L.	311	205		5000						
2100	31	A.L.	380	224		1800	28	A.L.	298	197		S.L.						

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG.) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.
(2) FUEL FLOWS (G.P.H.) ARE 5% CONSERVATIVE
(3) RANGE IS BASED ON FUEL MILEAGE TAKEN AT 25,000 FT. ALT. ONLY

EXAMPLE

AT 100,000 LB. GROSS WEIGHT WITH 2000 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF GAL.) TO FLY 660 STAT. AIRMILES AT 10,000 FT. ALTITUDE MAINTAIN 2400 RPM AND 43.5 IN. MANIFOLD PRESSURE WITH MIXTURE SET: A.R.

LEGEND

ALT. :	PRESSURE ALTITUDE	F.R. :	FULL RICH
M.P. :	MANIFOLD PRESSURE	A.R. :	AUTO-RICH
GPH :	U.S. GAL. PER HOUR	A.L. :	AUTO-LEAN
TAS :	TRUE AIRSPEED	C.L. :	CRUISING LEAN
KTS. :	KNOTS	M.L. :	MANUAL LEAN
S.L. :	SEA LEVEL	F.T. :	FULL THROTTLE

DATA AS OF 7-1-44 BASED ON: ESTIMATES

RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure 105 — Flight Operation Instruction Chart (Sheet 5 of 6 Sheets)

AAFMC-528
4-1-44

AIRCRAFT MODEL(S)	FLIGHT OPERATION INSTRUCTION CHART	EXTERNAL LOAD ITEMS
B-29		NONE
ENGINE(S): R-3350-13, -21, -23 & -23A	CHART WEIGHT LIMITS: 90,000 TO 80,000 POUNDS	NUMBER OF ENGINES OPERATING: 4

LIMITS	R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	CYL. TEMP.	TOTAL G.P.H.
WAR EMERG.							
MILITARY POWER	2600	47.5		A.R.	5	260°	1130

FOR DETAILS SEE POWER PLANT CHART (FIG. SECT.III)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING(1) MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).(1) TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES (3)		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
			SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING(1)								
690	600	2000	820	710	1200	1040	1360	1180	2000	REFER	TO
620	540	1800	740	640	1080	940	1220	1060	1800		
550	480	1600	650	570	960	830	1090	940	1600	MAXIMUM	RANGE
480	420	1400	570	500	840	730	950	820	1400	CONTROL	CURVE
410	360	1200	490	430	720	620	820	710	1200		
340	300	1000	410	350	600	520	680	590	1000		
270	240	800	330	280	480	410	540	470	800		
200	180	600	250	210	360	310	410	350	600		
130	120	400	160	140	240	210	270	240	400		
60	60	200	80	70	120	100	130	120	200		

MAXIMUM CONTINUOUS						PRESS	(.41 STAT. (NAUT.) MI./GAL.)					
R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT.(2) G.P.H.	APPROX. T.A.S. M.P.H.	APPROX. T.A.S. KTS.	ALT. FEET	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT.(2) G.P.H.	APPROX. T.A.S. M.P.H.	APPROX. T.A.S. KTS.
						40000						
--	--	--	--	--	--	35000	--	--	--	--	--	--
2400	43.5	A.R.	969	358		30000	2300	39	A.R.	835	342	
2400	43.5	A.R.	985	341		25000	2300	38	A.R.	790	324	
2400	43.5	A.R.	995	335		20000	2250	37	A.R.	778	319	
2400	43.5	A.R.	995	319		15000	2250	37	A.R.	729	299	
2400	43.5	A.R.	989	305		10000	2250	37	A.R.	707	290	
2400	43.5	A.R.	970	295		5000	2250	36	A.R.	658	270	
2400	43.5	A.R.	838	278		S.L.	2250	36	A.R.	626	257	

PRESS ALT. FEET	(.60 STAT. (NAUT.) MI./GAL.)						(.68 STAT. (NAUT.) MI./GAL.)					
	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT.(2) G.P.H.	APPROX. T.A.S. M.P.H.	APPROX. T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT.(2) G.P.H.	APPROX. T.A.S. M.P.H.	APPROX. T.A.S. KTS.
40000												
35000												
30000	--	--	--	--	--	--						
25000	2100	31	A.L.	474	285		--	--	--	--	--	--
20000	2100	31	A.L.	472	284		2000	28	A.L.	384	261	
15000	2100	31	A.L.	445	268		1950	28	A.L.	356	242	
10000	2100	31	A.L.	430	259		1850	28	A.L.	344	234	
5000	2100	31	A.L.	402	242		1800	28	A.L.	316	215	
S.L.	2100	31	A.L.	376	227		1850	28	A.L.	294	202	

PRESS ALT. FEET	MAXIMUM AIR RANGE					
	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. G.P.H.	APPROX. T.A.S. M.P.H.	APPROX. T.A.S. KTS.
40000						
35000						
30000		SEE NOTE ABOVE				
25000						
20000						
15000						
10000						
5000						
S.L.						

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB (SEE FIG.) PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.
(2) FUEL FLOWS (G.P.H.) ARE 5% CONSERVATIVE.
(3) RANGE IS BASED ON FUEL MILEAGE TAKEN AT 25,000 FT. ALT. ONLY.

EXAMPLE

AT 90,000 LB. GROSS WEIGHT WITH 1400 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF GAL.) TO FLY 800 STAT. AIRMILES AT 10000 FT. ALTITUDE MAINTAIN 2100 RPM AND 31 IN. MANIFOLD PRESSURE WITH MIXTURE SET: A.L.

LEGEND

ALT.	PRESSURE ALTITUDE	F.R.	FULL RICH
M.P.	MANIFOLD PRESSURE	A.R.	AUTO-RICH
GPH	U.S. GAL. PER HOUR	A.L.	AUTO-LEAN
TAS	TRUE AIRSPEED	C.L.	CRUISING LEAN
KTS.	KNOTS	M.L.	MANUAL LEAN
S.L.	SEA LEVEL	F.T.	FULL THROTTLE

DATA AS OF 7-1-44 BASED ON: ESTIMATES

RED FIGURES ARE PRELIMINARY. DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK

Figure 105 — Flight Operation Instruction Chart (Sheet 6 of 6 Sheets)

APPENDIX III

SUPPLEMENTARY FLIGHT CHARTS

SUPPLEMENTARY FLIGHT INFORMATION

Charts and discussions are included in this appendix which give takeoff distances, climb performance, ranges, speeds, recommended descent procedures and performance of the B-29 airplane. Although fuel flows in preceding sections of this Technical Order contain a 5% conservative factor, the information contained in this appendix contains no known margins and is intended to represent the average airplane with the following configuration. Extending the Radar Dome reduces range by 4% and speed by 5 mph.

SUMMARY

Before Takeoff

In order to complete engine warmup and power checkout with lowest possible head temperatures (under 220°) run engines on ground at lowest possible RPM (never over 700) for shortest possible time. Always head airplane into wind and use maximum cowl flaps. On run up set 2600 RPM and 47.5 inches manifold pressure.

Takeoff

Set wing flaps to 25°. Never start take off with engines above 220° C. Start take off with 15° cowl flaps; close during take off run to 7½° when airborne. Set all trim tabs neutral.

For normal takeoff use 2800 RPM and no brakes. "Walk" throttles forward to maintain directional control until rudder control is obtained. Advance throttles to 49 in. manifold pressure. At 90 mph relieve pressure on nose wheel and allow airplane to continue acceleration and fly off runway. Retract gear immediately. Allow airplane to accelerate to climbing speed as quickly as possible. Retract flaps at 160 mph. Reduce power when convenient. Minimum speed for 2 engine control is 130 mph.

For short takeoff line airplane up carefully on runway. Use 2800 RPM and hold airplane with brakes until 35 inches is obtained. Release brakes and advance throttles rapidly to 49 inches, steering with minimum braking until rudder becomes effective. Lower tail at 90 mph and continue to accelerate to takeoff speed. Retract gear immediately after takeoff. For shortest distance to clear close obstacles allow only a minimum speed increase. After clearing obstacles level off as much as possible and accelerate quickly to climbing speed. (195 IAS) Retract flaps at 160 mph. Reduce power when convenient.

Climb

Make all climbs at 195 to 205 mph I.A.S. Never climb at slower speeds. Set cowl flaps as required to cool cylinder heads to 248° C. or below. Do not use more than 3 inches cowl flap gap. For maximum climb performance, use 2400 RPM and 43.5 inches.

Level Flight

Use full throttle and set power with the turbo regulators. When full throttle powers give inadequate cabin airflow, use turbo boost setting No. 7 and part throttle. On an average day (60° F. on the ground) open cowl flaps ½ inch when below 10,000 feet, 1 inch between 10,000 and 20,000 feet and 2 inches above 20,000 feet. On a hot day (100° F. on the ground) open cowl flaps one more inch at each altitude. Cowl flap openings should never be greater than 3 inches, but may be less than those specified as head temperatures permit. Mixture auto rich above 2100 RPM and 31 inches.

Long Range Cruising

For maximum range, *hold the speed within the proper speed band.*

In setting up long range cruising condition after a climb, climb 500 to 1500 ft. above desired altitude. Descend to desired altitude at higher speeds and higher cowl flap settings than necessary for long range cruising in order to cool engines down. Set up correct cruising speed by use of elevators (cowl flaps at recommended openings) when desired altitude is reached. Adjust power to maintain altitude and adjust cowl flaps on individual engines to maintain proper cylinder head limits. Always be sure to use the recommended power settings and mixtures for long range cruising. Reset power every two or three hours to maintain correct cruising speeds. For long range climb use above climb instructions.

Recommended Power Settings

For recommended power settings see figure 23.

Approach

Move supercharger regulators to full on and propeller controls to 2400 RPM. Initial approach at 160 MPH with flaps 25°. Do not lower landing gear until sure of making field. Make final approach at 30 MPH above power-off stalling speed with flaps full down at end of runway. Maximum speed for full flaps is 180 MPH. Do not drag in at low altitude, as this causes high temperatures. In event of "go around" heads will exceed limits.

Landing

Make all landings with full flaps. Land on main gear with tail low. Open side windows in landing to hear and hence avoid sliding the tires. To "go around" use full throttle, full turbo, and 2600 RPM. Immediately raise flaps to 25°, and also raise gear.

TAKEOFF CONTROL CHART

The takeoff distances to clear the standard 50-foot obstacle, with flaps extended 25°, are presented in chart form and are based on actual takeoff tests. Ground runs may be obtained as noted on the chart. Average takeoff distances are shown, not minimums. Multiply these distances by .8 to find the minimum distances.

The upper left-hand portion of the chart is the familiar density altitude conversion chart where the outside air temperature and pressure altitude define the density altitude. The upper half of the chart shows curves for the takeoff distance on a hard-surfaced runway and zero-wind at gross weights from 80,000 pounds to 150,000 pounds. The approximate unstick speeds are also noted on the curves for these weights. The lower half of the chart has conversion scales for ground surface condition and head winds.

For the example shown on the chart:

1. CONDITION:

a. Outside Air Temperature = 35°C.

b. Pressure Altitude = —600 ft.

c. Airplane Weight at Takeoff = 115,000 lbs.

d. Runway Surface = short grass

e. Headwind = 11 MPH

2. QUESTIONS:

a. Density Altitude?

b. Unstick Speed?

c. Distance Covered?

3. ANSWERS:

a. Enter the altitude conversion chart at 35° C and go up to the —600 ft. pressure altitude. Read 1500 ft. density altitude.

b. Follow the arrows horizontally to half-way between the 110,000 and 120,000 pound lines. The unstick speed is approximately 120 MPH

c. Follow arrows straight down to the concrete surface line. This gives a takeoff distance of 4800 ft. for a concrete runway and no wind.

d. Follow curved lines to "short grass" surface and then straight down to zero wind.

e. Follow the wind lines to 11 MPH and then straight down to takeoff distance of 4700 feet for short grass runway and 11 MPH headwind. The ground run is about 70% of 4700 ft. or 3290 feet.

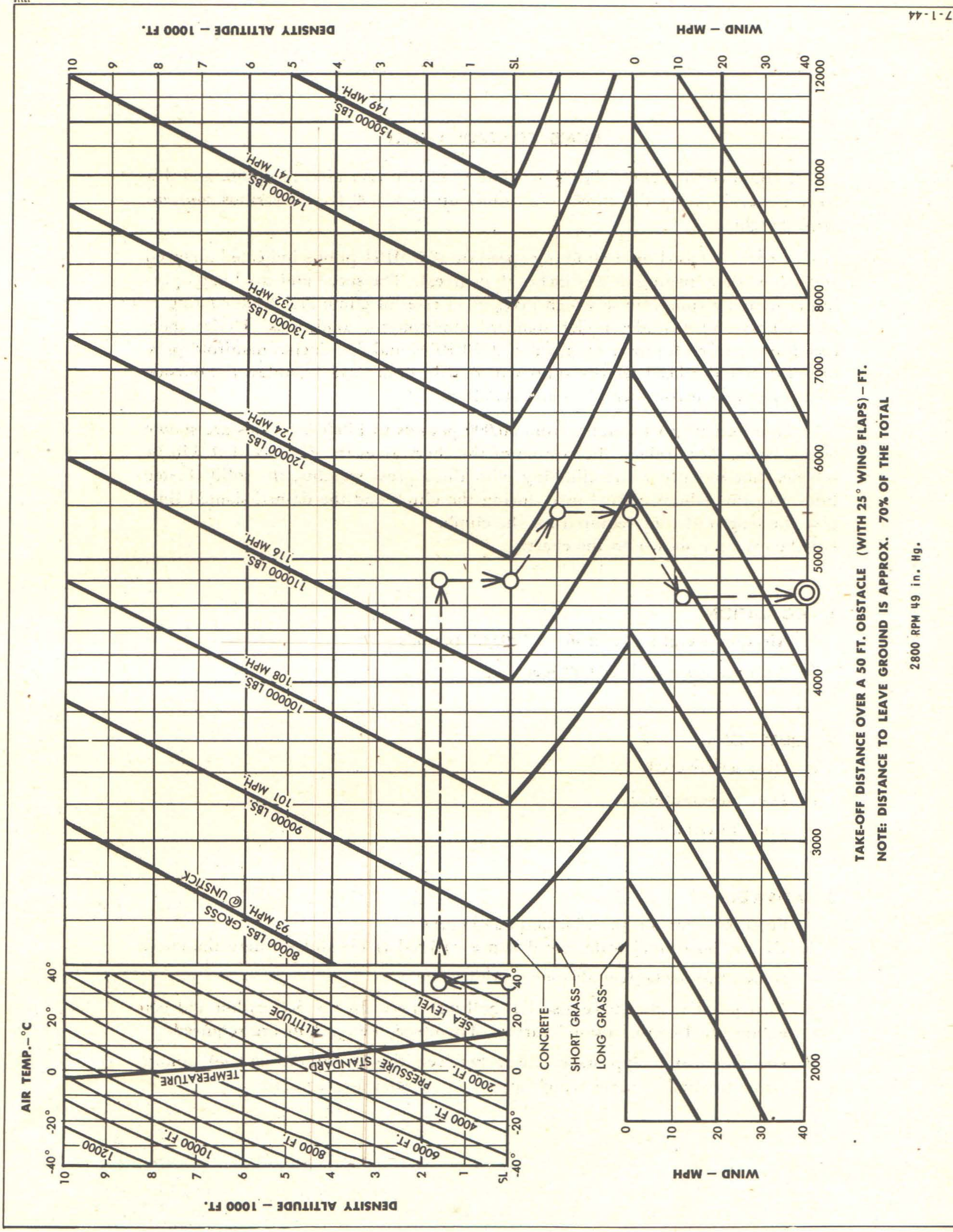


Figure 106 — Take-off Control Chart

CLIMB CONTROL CHART

The climb control chart shows the time to climb, fuel used in climb, and distance traveled during the climb to altitudes up to 30,000 feet at various *constant* gross weights.

This chart is based on a climbing speed of 195 MPH pilot's indicated airspeed and a cowl flap opening of 2½ inches (9 degrees). The speed and cowl flap opening represent a compromise which gives good rates of climb and good cooling at all weights and altitudes under standard atmospheric conditions. Under these conditions and with power obtained at 2400 RPM and 43.5 inches manifold pressure, the cylinder head temperatures will remain under 248°C. unless the outside air temperature is considerably above standard.

Seven different gross weights from 80,000 pounds to 140,000 pounds are shown on the chart. The scale at the bottom of the chart gives the distance that will be traveled horizontally while climbing with these gross weights, the solid slanted lines give the gallons of fuel used during the climb and the dashed slanted lines give the length of time required for the climb.
For the example shown on the chart:

1. CONDITION:

a. Airplane weight at takeoff = 120,000 pounds

b. Altitude desired = 20,000 feet

2. QUESTIONS:

a. Distance covered?

b. Fuel consumption?

c. Time to climb?

3. ANSWERS:

a. Enter the chart on the 120,000 pound curve

b. On the horizontal scale, the distance covered is 131 miles where the curve crosses the 20,000 feet altitude vertical scale

c. That point in the curve also lies half-way between the 500 gallon and 600 gallon "fuel consumption" curves. Therefore, *550 gallons* are required.

d. The same point appears half-way between the 30 minute and 40 minute "time to climb" curves which means *35 minutes* are required.

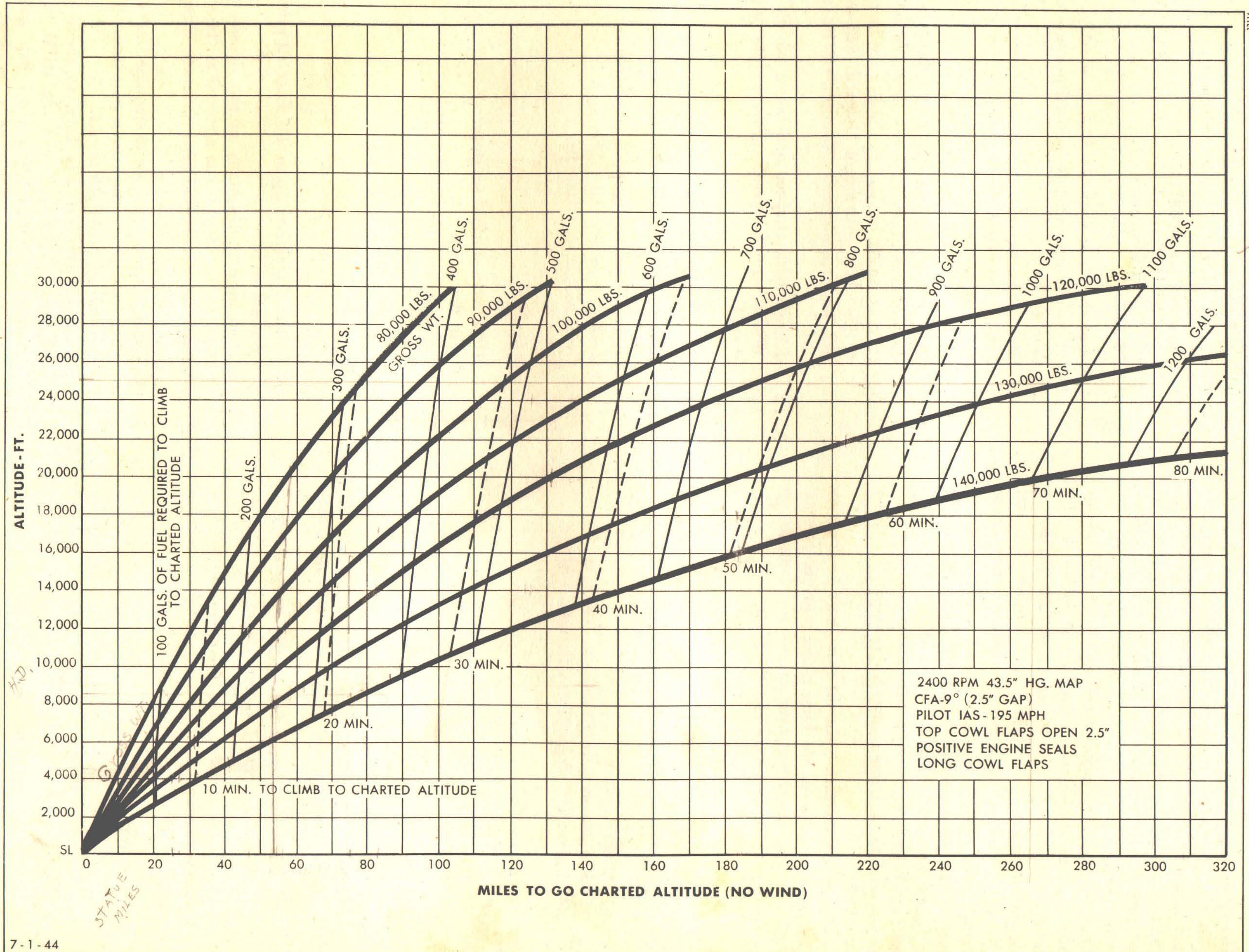


Figure 107 — Climb Control Chart

COMPOSITE CRUISING CONTROL CHART

The chart is intended to give true airspeed directly from the instrument readings of outside air temperature, pressure altitude and instrument airspeed. The chart accounts for corrections due to pitot position, compressibility, temperature, altitude, and all instruments are assumed to be free of mechanical errors.

The chart also includes curves of RPM and manifold pressure combinations required to obtain the desired true airspeed at the observed altitude (based on 105,000 pounds gross weight). Fuel consumption and the required cowl flap gap are noted along these curves. The cowl flap gap is a compromise chosen to provide a minimum number of standard settings for adequate cooling under all conditions. With these settings, head temperatures will remain below 248° C. unless outside air temperatures are considerably above standard.

Under no consideration should this chart be used by the pilot or engineer for long range cruising powers. Refer to the operating instructions for long range cruising conditions throughout the flight.

EXAMPLES

I. To find true airspeed from instrument airspeed.

a. CONDITION:

(1) Observed O.A.T. = 10°C.
(2) Known pressure altitude = 10,000 ft.
(3) Instrument airspeed = 228 mph, I.A.S.

b. QUESTIONS:

(1) True airspeed?

c. ANSWER:

(1) Enter chart with the observed O.A.T. at (A)
(2) Follow constant temperature line to known pressure altitude at (B)
(3) Follow constant density altitude line to the instrument airspeed on the horizontal scale to (C) and
(4) Read the corresponding TRUE airspeed on the true airspeed diagonal lines (263 MPH)

2. To find true airspeed and instrument airspeed for desired pressure altitude and power conditions (gross weight over 105,000 pounds)—

a. CONDITION:

(1) O.A.T. = 10°C
(2) Pressure altitude = 10,000 ft.
(3) RPM = 2200
(4) MAP = 35 inches
(5) Cowl flap gap = 1 inch
(6) Gross weight = 120,000 lbs.

b. QUESTIONS

(1) True airspeed?
(2) Instrument airspeed?

c. ANSWERS:

(1) Enter the chart with the O.A.T. at (A)
(2) Follow the arrows to the desired pressure altitude at (B)
(3) Then move horizontally at this density altitude to the desired power curve at (D).
(4) Drop vertically to the airplane gross weight at (E)
(5) Then follow along parallel to the weight conversion lines to the base line at (F) and,
(6) Then vertically upward to the density altitude at (C) where instrument airspeed (228 mph, IAS) and true airspeed (263 mph) can be read.

3. To find instrument airspeed and power conditions for a desired true airspeed (gross weight below 105,000 lbs.)

a. CONDITION:

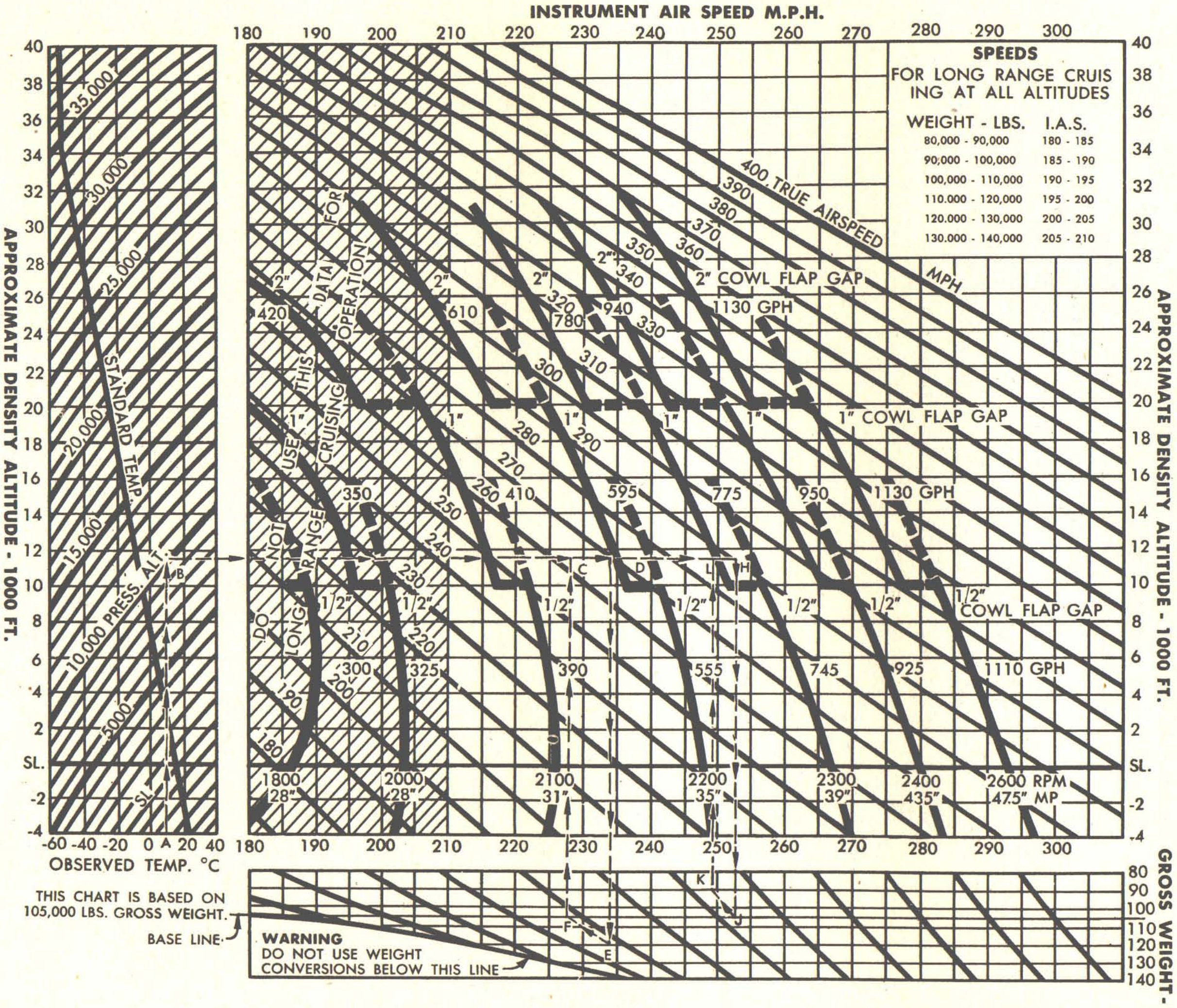
(1) Observed O.A.T. = 10°C.
(2) Observed pressure altitude = 10,000 ft.
(3) Desired true airspeed = 292 mph
(4) Gross weight = 90,000 lbs.

b. QUESTIONS:

(1) RPM and manifold pressure?
(2) Cowl flap gap?
(3) Fuel consumption?
(4) Instrument airspeed?

c. ANSWERS:

(1) Enter the chart with the observed O.A.T. at (A)
(2) Follow the arrows up to the observed pressure altitude at (B)
(3) Then move horizontally at this density altitude to the desired true airspeed at (H)
(4) Read the corresponding instrument airspeed (253 mph, IAS)
(5) From (H) project down to the base line at (J)
(6) Then parallel to the conversion lines to the airplane gross weight at (K)
(7) Then project vertically back to the density altitude at (L) and read the RPM (2300) manifold pressure (39") cowl flap gap (1 inch) and fuel consumption required (775 GPH).



NOTE: THIS CHART MAKES ALL NECESSARY CORRECTIONS TO OBTAIN TRUE AIRSPEED ASSUMING ZERO INSTRUMENT ERRORS AND APPLIES TO B-29 AIRPLANES ONLY.

USE OF CHART

Refer To Operating Instructions For Long Range Cruising Condition Throughout Flight.

Do Not Use This Chart For Long Range Cruising Operation. This Chart Can Be Read Directly For 105,000 Lbs. Gross Weight Only. For Other Weights Use Conversion Scales At Bottom Of Chart As Illustrated By The Sample Solution. An Airspeed Pitot Position Correction Of –1/5% Has Been Included In This Chart.

SAMPLE PROBLEM

To Find Instrument Airspeed And Power Conditions For A Desired True Airspeed.

CONDITIONS:

1. Observed O.A.T. - 10°C.
2. Observed Pressure Altitude—10,000 Ft.
3. Desired True Airspeed— 292 MPH.
4. Gross Weight— 90,000 Lbs.

QUESTIONS:

1. RPM And Manifold Pressure.
2. Cowl Flap Gap.
3. Fuel Consumption.
4. Instrument Airspeed.

ANSWERS:

1. Enter The Chart With The Observed O.A.T. At (A)
2. Follow The Arrows Up To The Observed Pressure Altitude At (B).
3. Then Move Horizontally At This Density Altitude To The Desired True Airspeed (292 MPH) At (H).
4. Read The Corresponding Instrument Airspeed (253 MPH IAS).
5. From (H) Project Down To The Base Line At (J).
6. Then Parallel To The Conversion Lines To The Airplane Gross Weight At (K).
7. Then Project Vertically Back To The Density Altitude At (L) And Read The RPM (2300), Manifold Pressure (39"), Cowl Flap Gap (1"), And Fuel Consumption (775 GPH).

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Figure 108 — Composite Cruising Control Chart

DESCENT CONTROL

Studies on various methods of descending indicate that as long as the airplane is in the clean condition (wing flaps up, gear retracted and minimum cowl flaps) and the long range cruising speeds are maintained, the rate of descent has practically no effect on the range and no chart is needed for control. In planning long range flights, 2½ miles can be added to the level flight distance for each 1000 feet of altitude providing the descent is in the same direction as the level flight. This simple and practical result obviates the need for a chart.

For example—

CONDITION:

a. Flight altitude = 20,000 feet
b. 200 miles can be flown at 20,000′ with the amount of gasoline available.

QUESTION:

a. How will range be increased in descent?

ANSWER:

a. Add 2½ miles for each 1000 feet or 50 miles for descent

FLIGHT OPERATIONS CHARTS

Instructions

1. Use these charts to determine range operating conditions and average airspeed.
2. Enter range chart at gallons of fuel available and go to column containing range equal to or slightly greater than range desired. Read letter at top of this column opposite headwind condition.
3. Enter operations chart at weight of airplane (light, medium or heavy). Desired range can be accomplished at flight altitude by operating with power condition at top of column where range letter appears. If desired range letter does not appear use next higher letter (between "A" and "M" or between "R" and "V")
4. "X" in blank space on operations chart indicates power condition not sufficient for flight at specified weight and altitude.

EXAMPLE (PLANNING FLIGHT)

Range desired	1500 miles
Flight altitude	15,000 ft.
Airplane weight	120,000 lbs.
Desired true airspeed	300 mph
No headwind	

Enter operations chart at medium weight, 15,000 ft. altitude. Under 2300 RPM and 39 in. M.A.P. 299 mph true airspeed appears with letter "E". (Thus flight time will be approximately 5 hours.)

Enter range chart under no headwind condition at column "E". Reading down column "E" to 1505 miles find 4000 gallons of fuel required. From climb chart find 310 gallons required to climb to 15,000 ft. Allow 80 gallons for warmup and takeoff and the total fuel required will be 4390 gallons.

From the loading chart it can be seen with 4400 gallons of fuel approximately 14,500 lbs. of bombs, ammunition and equipment can be carried without exceeding 120,000 lbs. gross weight.

EXAMPLE (RETURNING TO BASE)

Range desired	500 miles
Fuel remaining	1600 gallons
Flight altitude	25,000 ft.

Objective reached and bombs dropped
Airplane weight estimated at 90,000 lbs.
Headwind 35 mph estimated 10% of desired true airspeed

Enter range chart at 1600 gallons and read 535 miles below letter "E" for 10% headwind condition.

In operation chart opposite light weight and 25,000 feet altitude letter "E" does not appear but the next higher letter "F" appears under 2300 RPM and 39" M.A.P. Average true airspeed is 327 mph. This is maximum speed and power at which mission can be completed.

For greater reserve fly at long range cruise condition.

* WHEN 2000 RPM AND 28 IN. Hg. IS INSUFFICIENT POWER TO HOLD CRUISING SPEED USE HIGHER RECOMMENDED POWER SETTING SHOWN ON CHART

FOUR ENGINE OPERATION

			MILITARY POWER	CLIMB AND HIGH POWER CRUISE	CRUISE	CRUISE	CRUISE	CRUISE	LONG RANGE CRUISE		
RPM			2600	2400	2300	2200	2100	2000	AS REQUIRED*		
MANIFOLD PRESSURE			47.5″	43.5″	39″	35″	31″	28″	28″ 2000 or Less*		
MIXTURE				AUTO RICH	AUTO RICH	AUTO RICH	AUTO LEAN	AUTO LEAN	AUTO LEAN *		
GALLONS PER HOUR			1130	950	775	595	410	350			
MAX. CYL. TEMP. °C.			260	260 CLIMB 248 LEVEL	248	238	232	232	232		
	ALTITUDE ↓	C.F. GAP ↓	TAS ↓	TAS ↓	TAS ↓	TAS ↓	TAS ↓	TAS ↓	PILOT'S IAS ↓		
HEAVY WEIGHT 120,000 - 140,000 POUNDS	SEA LEVEL	½″	A 281	B 269	D 256	F 234	X	X	U	120,000 - 130,000 POUNDS 200 - 205 IAS	130,000 - 140,000 POUNDS 205 - 210 IAS
	5,000	½″	A 294	B 283	D 269	F 248	X	X	U		
	10,000	½″	A 310	C 298	D 282	G 262	X	X	U		
	15,000	1″	A 316	C 306	D 288	X	X	X	T		
	20,000	1″	B 332	C 318	E 300	X	X	X	T		
	25,000	2″	B 331	C 312	X	X	X	X	R		
	30,000	2″	X	X	X	X	X	X	X		
MEDIUM WEIGHT 100,000 - 120,000 POUNDS	SEA LEVEL	½″	A 286	B 274	D 262	G 242	J 220	X	K	100,000 - 110,000 POUNDS 190 - 195 IAS	110,000 - 120,000 POUNDS 195 - 200 IAS
	5,000	½″	A 300	C 289	D 275	G 256	J 235	X	K		
	10,000	½″	A 316	C 304	E 290	G 272	J 249	X	K		
	15,000	1″	B 324	C 313	E 299	G 280	J 255	X	V		
	20,000	1″	B 341	D 328	E 314	G 295	X	X	V		
	25,000	2″	B 345	D 330	E 315	X	X	X	U		
	30,000	2″	C 358	D 342	F 326	X	X	X	T		
LIGHT WEIGHT 80,000 - 100,000 POUNDS	SEA LEVEL	½″	A 291	B 278	E 266	G 247	J 227	L 208	M	80,000 - 90,000 POUNDS 180 - 185 IAS	90,000 - 100,000 POUNDS 185 - 190 IAS
	5,000	½″	A 305	C 294	E 281	G 262	J 242	L 224	M		
	10,000	½″	B 322	C 310	E 297	G 280	K 260	L 241	M		
	15,000	1″	B 331	C 319	E 306	H 289	K 269	L 247	M		
	20,000	1″	B 348	D 336	F 322	H 306	K 284	L 262	M		
	25,000	2″	C 354	D 340	F 327	H 311	L 286	X	L		
	30,000	2″	C 368	E 355	F 342	I 324	X	X	V		

ONE ENGINE OUT

			MILITARY POWER	CLIMB AND HIGH POWER CRUISE	CRUISE	CRUISE	CRUISE	LONG RANGE CRUISE		
RPM			2600	2400	2300	2200	2100	AS REQUIRED*		
MANIFOLD PRESSURE			47.5″	43.5″	39″	35″	31″	28″ 2000 or Less*		
MIXTURE			AUTO RICH	AUTO RICH	AUTO RICH	AUTO RICH	AUTO LEAN	AUTO LEAN *		
GALLONS PER HOUR			850	715	580	445	310			
MAX. CYL. TEMP. °C.			260	260 CLIMB 248 LEVEL	248	238	232	232		
	ALTITUDE ↓	C.F. GAP ↓	TAS ↓	TAS ↓	TAS ↓	TAS ↓	TAS ↓	PILOT'S IAS ↓		
HEAVY WEIGHT 120,000 - 140,000 POUNDS	SEA LEVEL	½″	B 244	D 232	E 217	X	X	T	120,000 - 130,000 POUNDS 200 - 205 IAS	130,000 - 140,000 POUNDS 205 - 210 IAS
	5,000	½″	B 257	D 244	X	X	X	S		
	10,000	½″	C 268	D 252	X	X	X	S		
	15,000	1″	C 271	X	X	X	X	R		
	20,000		X	X	X	X	X	X		
	25,000		X	X	X	X	X	X		
	30,000		X	X	X	X	X	X		
MEDIUM WEIGHT 100,000 - 120,000 POUNDS	SEA LEVEL	½″	B 251	D 239	F 227	H 208	X	U	100,000 - 110,000 POUNDS 190 - 195 IAS	110,000 - 120,000 POUNDS 195 - 200 IAS
	5,000	½″	C 264	D 253	F 239	H 219	X	U		
	10,000	½″	C 278	E 265	F 248	X	X	U		
	15,000	1″	C 285	E 271	F 254	X	X	T		
	20,000	1″	D 299	E 283	X	X	X	T		
	25,000	2″	D 298	X	X	X	X	S		
	30,000		X	X	X	X	X	X		
LIGHT WEIGHT 80,000 - 100,000 POUNDS	SEA LEVEL	½″	C 256	D 245	F 234	I 217	L 197	M	80,000 - 90,000 POUNDS 180 - 185 IAS	90,000 - 100,000 POUNDS 185 - 190 IAS
	5,000	½″	C 270	D 259	F 247	I 230	L 210	M		
	10,000	½″	C 283	E 271	G 257	H 243	L 223	M		
	15,000	1″	D 293	E 281	G 268	H 252	X	V		
	20,000	1″	D 308	F 295	H 282	J 264	X	V		
	25,000	2″	E 314	F 298	H 284	X	X	I		
	30,000	2″	E 324	G 307	X	X	X	U		

TWO ENGINES OUT

			MILITARY POWER	CLIMB AND HIGH POWER CRUISE	CRUISE	LONG RANGE CRUISE		
RPM			2600	2400	2300	AS REQUIRED*		
MANIFOLD PRESSURE			47.5″	43.5″	39″	28″ 2100 or Less*		
MIXTURE			AUTO RICH	AUTO RICH	AUTO RICH	AUTO LEAN *		
GALLONS PER HOUR			565	475	385			
MAX. CYL. TEMP. °C.			260	260 CLIMB 248 LEVEL	248	232		
	ALTITUDE ↓	C.F. GAP ↓	TAS ↓	TAS ↓	TAS ↓	PILOT'S IAS ↓		
HEAVY WEIGHT 120,000 - 140,000 POUNDS	SEA LEVEL		X	X	X	X		
	5,000		X	X	X	X		
	10,000		X	X	X	X		
	15,000		X	X	X	X		
	20,000		X	X	X	X		
	25,000		X	X	X	X		
	30,000		X	X	X	X		
MEDIUM WEIGHT 100,000 - 120,000 POUNDS	SEA LEVEL	1″	D 200	X	X	S	100,000 - 110,000 POUNDS 180 - 185 IAS	110,000 - 120,000 POUNDS 185 - 190 IAS
	5,000		X	X	X	X		
	10,000		X	X	X	X		
	15,000		X	X	X	X		
	20,000		X	X	X	X		
	25,000		X	X	X	X		
	30,000		X	X	X	X		
LIGHT WEIGHT 80,000 - 100,000 POUNDS	SEA LEVEL	1″	E 211	G 201	H 188	U	80,000 - 90,000 POUNDS 170 - 175 IAS	90,000 - 100,000 POUNDS 175 - 180 IAS
	5,000	1″	E 223	G 211	X	U		
	10,000	1″	F 232	G 220	X	U		
	15,000	1½″	F 238	X	X	G		
	20,000		X	X	X	X		
	25,000		X	X	X	X		
	30,000		X	X	X	X		

7-1-44

Figure 109 — Operation Chart

FUEL - AVAILABLE GALLONS

NO HEADWIND	A	B	C	D	E	F	G	H	I	J	K	L	M	R	S	T	U	V
HEADWIND 10% of TAS	B	C	D	E	F	G	H	I	J	K	L	M		S	T	U	V	
HEADWIND 20% of TAS	C	D	E	F	G	H	I	J	K	L	M			T	U	V		
HEADWIND 30% of TAS	D	E	F	G	H	I	J	K	L	M				U	V			
HEADWIND 40% of TAS	E	F	G	H	I	J	K	L	M					V				
200	50	60	70	80	90	100	110	120	130	140	150	160	170	55	65	75	85	100
400	102	120	125	130	140	160	175	190	205	220	240	260	290	115	130	150	170	220
600	155	173	185	205	220	240	260	280	305	340	365	395	430	175	195	225	260	330
800	203	230	245	270	290	320	345	375	410	450	490	530	570	235	265	300	350	435
1000	258	285	305	335	365	400	435	470	510	560	610	660	710	295	330	375	430	540
1200	308	340	370	405	445	485	525	570	620	670	730	800	860	350	400	460	530	660
1400	360	400	430	475	515	560	610	660	715	780	850	920	1000	425	480	540	630	770
1600	410	460	495	535	590	640	700	765	830	905	985	1070	1150	490	555	615	730	900
1800	462	510	555	605	665	725	790	860	940	1020	1110	1205	1310	560	635	710	830	1020
2000	513	565	620	675	740	805	880	960	1045	1140	1240	1350	1460	630	710	800	930	1150
2200	560	620	680	745	815	885	970	1060	1150	1260	1370	1490	1620	710	795	895	1040	1270
2400	620	680	740	810	885	965	1055	1160	1260	1370	1500	1630	1770	790	875	990	1150	1400
2600	670	740	805	880	965	1050	1150	1260	1370	1500	1630	1775	1930	865	960	1090	1260	1530
2800	725	800	870	965	1040	1130	1240	1355	1480	1615	1760	1910	2085	940	1050	1185	1375	1670
3000	778	855	935	1020	1120	1220	1330	1455	1590	1735	1895	2065	2250	1025	1140	1290	1485	1800
3200	830	910	1000	1095	1200	1305	1425	1560	1700	1860	2030	2215	2415	1110	1230	1390	1600	1930
3400	882	970	1065	1165	1270	1390	1520	1665	1810	1980	2170			1195	1320	1490	1720	2070
3600	935	1030	1130	1235	1350	1475	1610	1765	1925	2105	2305			1275	1410	1590	1840	2210
3800	990	1090	1190	1300	1425	1560	1710	1870	2035	2230	2445			1365	1510	1695	1965	2350
4000	1040	1150	1255	1375	1505	1645	1800	1970	2150	2360	2590			1450	1600	1800	2090	2490
4200	1097	1203	1320	1445	1585	1730	1900	2080	2270	2480	2725			1545	1700	1910	2215	2640
4400	1150	1265	1385	1520	1665	1815	1985	2185	2380	2570	2810			1635	1800	2030	2350	2780
4600	1205	1323	1450	1585	1740	1900	2085	2285	2495	2740	3000			1725	1905	2145	2480	2930
4800	1260	1382	1510	1655	1815	1985	2175	2390	2610	2870	3150			1820	2010	2260	2610	3075
5000	1310	1440	1580	1730	1895	2075	2270	2490	2730	3000	3290			1920	2120	2385	2750	3230
5200	1370	1500	1645	1800	1975	2165	2370	2610	2845	3125	3430			2010	2225	2505	2890	3370
5400	1425	1560	1710	1870	2055	2250	2470	2710	2965	3260	3580			2110	2340	2630	3030	3530
5600	1480	1620	1775	1950	2140	2340	2565	2815	3075	3390	3730			2210	2450	2755	3130	3680
5800	1530	1680	1845	2020	2215	2425	2665	2925	3195	3520	3865			2320	2565	2890	3310	3835
6000	1585	1740	1910	2090	2295	2510	2760	3030	3310	3650	4010			2430	2680	3020	3455	3990
6200	1640	1800	1975	2165	2375	2600	2860	3140	3430	3780	4150			2530	2790	3150	3600	4150
6400	1695	1860	2040	2240	2455	2690	2950	3250	3550	3915	4300			2640	2920	3290	3755	4305
6600	1745	1920	2105	2310	2540	2780	3050	3350	3675	4050	4440			2750	3040	3430	3845	4465
6800	1800	1985	2175	2390	2620	2870	3150							2870	3170	3570	4045	
7000	1855	2040	2140	2455	2700	2960	3250							2990	3300	3710	4195	
7200	1910	2100	2305	2530	2780	3045	3350							3100	3425	3850	4345	
7400	1970	2160	2370	2605	2860	3135	3445							3220	3560	4005	4500	
7600	2020	2225	2440	2685	2950	3230	3545							3345	3700	4150	4650	
7800	2075	2280	2600	2750	3020	3320	3640							3470	3835	4300	4810	
8000	2130	2340	2570	2820	3100	3400	3740							3595	3980	4450	4970	
8200	2185	2400	2635	2895	3185	3490	3835							3720	4120	4600	5120	
8400	2240	2460	2700	2970	3270	3590	3935							3850	4770	4750	5285	
8600	2295	2520	2770	3040	3345	3675	4030							3980	4420	4900	5440	
8800	2350	2580	2840	3120	3430	3760	4130							4115	4560	5050	5605	
9000	2400	2640	2900	3185	3505	3850	4230							4250	4700	5200	5765	
9200	2460	2700	2970	3265	3590	3940	4325							4385	4850	5360	5930	
9400	2515	2760	3035	3340	3680	4030	4425							4530	5000	5520	6090	
9600	2565	2820	3100	3410	3750	4120	4520							4670	5150	5670	6260	
9800	2625	2890	3170	3485	3835	4215	4620							4805	5300	5830	6420	
10000	2675	2940	3240	3560	3910	4295	4720							4950	5445	5985	6585	7-1-44

Figure 110 — Range Chart

MAXIMUM RANGE CONTROL CHART

The maximum Range Control Chart gives optimum speeds, approximate power settings, mileage, and resulting ranges for various gross weights. The values shown on this chart will not be obtained without strict attention being paid to the operating instructions. The range curves in this chart are based on operation at the recommended long range cruising speeds and at the cowl flap gaps shown. The cowl flap gaps have been selected for cool day operation and should give marginal cooling at high weights and more than adequate cooling at low weights. On hot days more cowl flaps will be needed than shown here. Decrease the range values obtained from this chart by 10% for a 1 inch increase in cowl flap gap. Never exceed 3 inches of cowl flap opening in level flight, because reductions in head temperatures are small above this setting. Always close cowl flaps as much as possible, and always maintain long range cruising speeds. The bad effects of low airspeeds and large cowl flap openings cannot be overemphasized.

The range chart shows how the range of the airplane varies with gross weight and altitude. As fuel is used up and the airplane's weight decreases (1 gallon fuel = 6 pounds) the range or miles traveled increases. An airplane loaded with gasoline to a gross weight of 140,000 pounds will travel 3610 miles at 15,000 feet altitude before the gross weight drops to 100,000 pounds. 40,000 pounds (6666 gallons) of gasoline are used. If the initial weight had been 120,000 pounds instead, the number of miles traveled would have been 3610 minus1500 or 2110 miles while using 30,000 pounds (5,000 gallons) of gasoline.

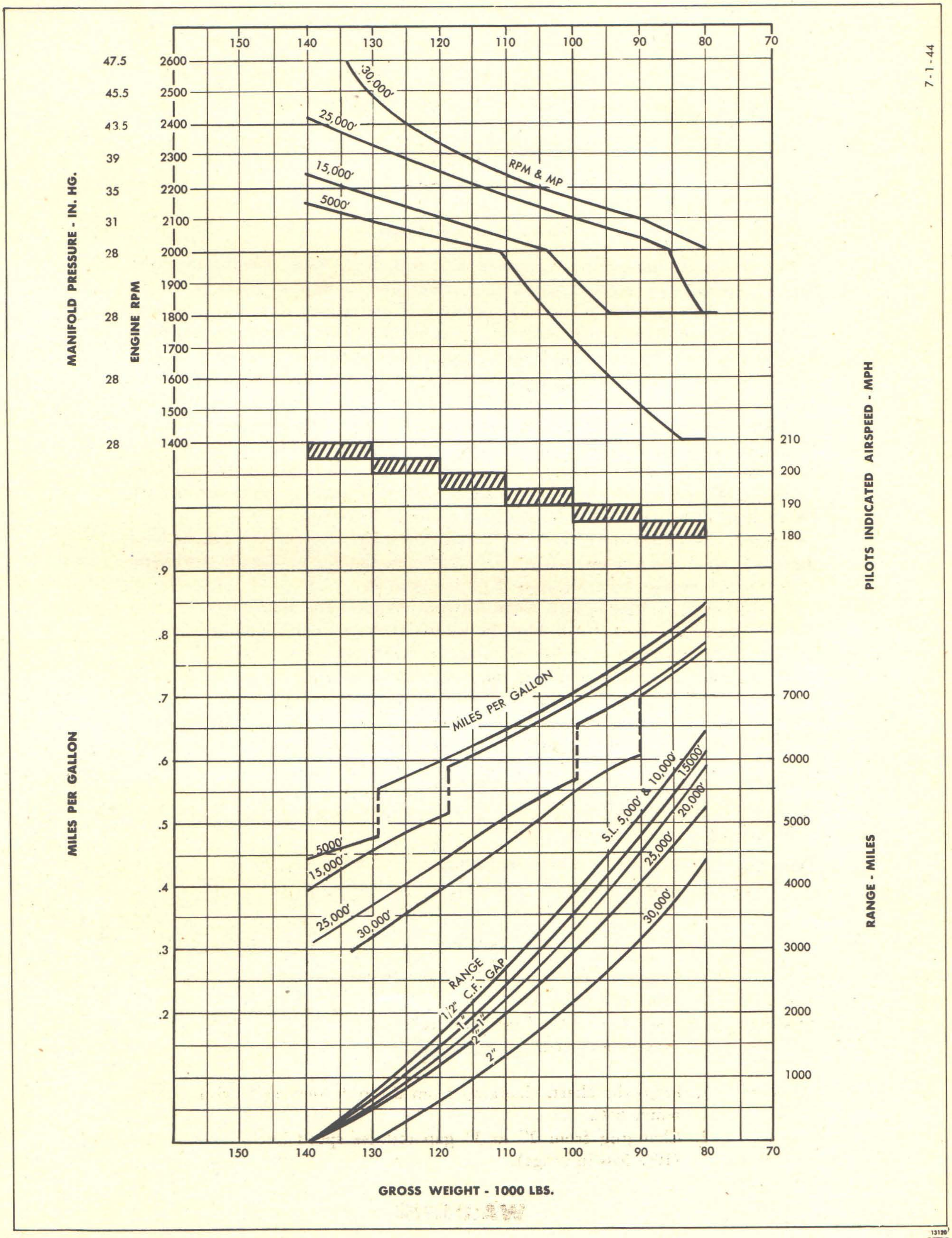

Figure 111 — Maximum Range Control Chart

COWL FLAP OPENING

Two things are immediately apparent from this chart. *First,* opening the cowl flaps is expensive in terms of speed. The lower line shows that 2.2 mph, I.A.S., are lost for each increase in cowl flap opening of one degree (0.3 inch). *Second,* opening the cowl flaps over 8 degrees (2¼ inches) has little effect on the cylinder head temperatures in level flight. In fact, opening the cowl flaps from 8 degrees to 16 degrees only reduces the head temperatures by 5 degrees centigrade. The chart also shows the amount of power which goes into cooling. Whenever the cowl flaps are opened 3 inches (about 10°), 25% of the engine power is used in merely pushing air through the cowl. An increase of 1" cowl flap gap will decrease the range of the airplane by 10%. Therefore a compromise between engine temperatures and maximum range must be realized depending upon the relative importance of these two factors and the immediate objectives.

In general the following cowl flap settings will give adequate cooling in level flight operation and may be used as a first approximation for setting the cowl flaps.

A. On an average day (15°C or 60° F on the ground).
   1. Open cowl flaps ½ inch when between sea level and 10,000 feet.
   2. Open cowl flaps 1 inch when between 10,000 and 20,000 feet.
   3. Open cowl flaps 2 inches when above 20,000 feet.

B. On a hot day (38° C or 100° F on the ground).
   1. Open flaps one more inch at each altitude shown above.

Never exceed 3 inches of cowl flap opening in level flight.

EXAMPLE

Condition: 1. Cowl flap increased from 2.0" to 3.0" during cruising flight.

Question: 1. Reduction in head temperature?
2. Loss in airspeed?

Answer: 1. From the chart, changing from 2" to 3" decreases cylinder head temp. 6°C.
2. Changing from 2" to 3" gap reduces speed by 7.5 mph, I.A.S. (10% loss in range).

WARNING

These data apply only to long chord cowl flaps.

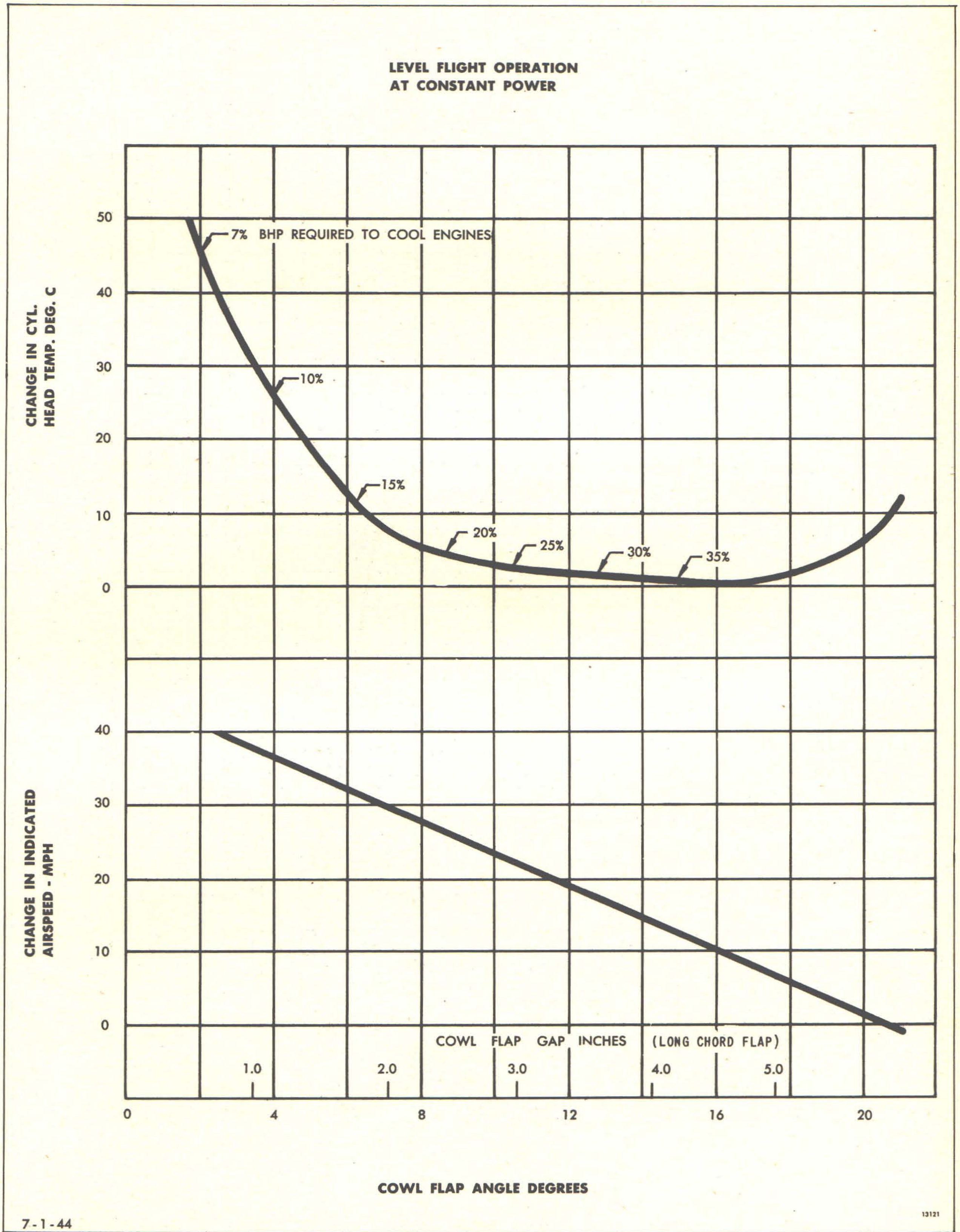

Figure 112 — Effect of Cowl Flaps on Cyl Hd Temp and IAS

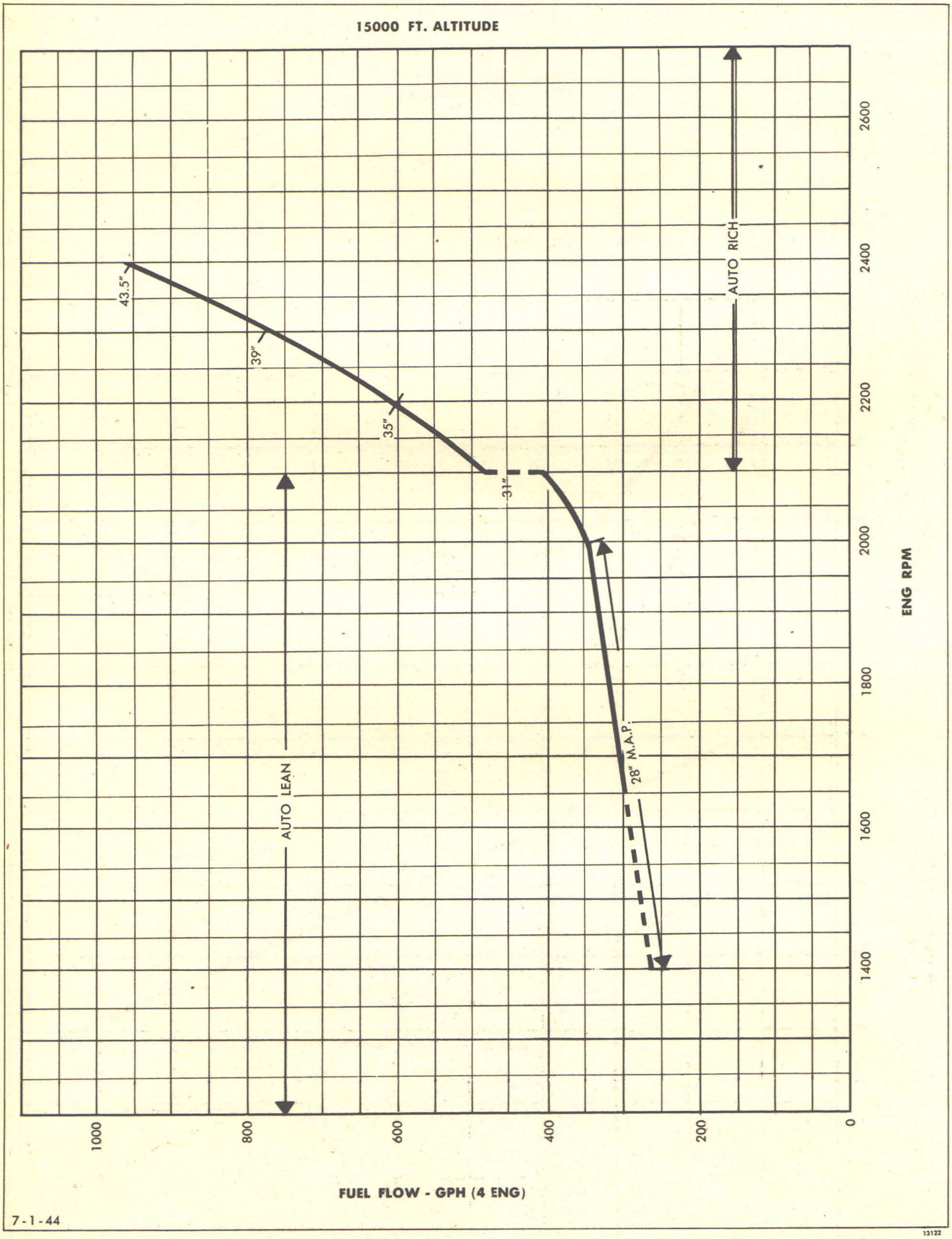

Figure 113 — Fuel Consumption Curve

MAXIMUM RANGE PROCEDURES

In attempting to get the maximum possible range from the B-29 airplane certain range procedures must be used. Maximum range is obtained at neither maximum speed nor at the speed for minimum fuel flow. It occurs at an intermediate speed where the maximum number of miles are traveled for each gallon of fuel consumed. It has been found that this *optimum range speed* for the B-29 airplane varies with weight but is not affected much by altitude, temperature, drag, etc.; these latter items will affect the maximum range *but not the speed* at which to obtain it.

As an example of several factors involved in the range problem, fig. 115 has been prepared. This chart shows the fuel mileage in miles per gallon plotted against indicated air speed. The conditions shown are at 90,000 lbs. and 15,000 ft. altitude. A different but similar chart can be drawn for each weight and altitude.

Diagonal lines of constant power are shown. At a given power there will be a fixed rate of fuel flow and the fuel mileage will be proportional to the speed. At each power there will be a fuel mileage and speed lying along these lines and varying with airplane drag. Plotted on fig. 115 are curves of fuel mileage versus speed at various cowl flap openings.

It is obvious that speed is a major controlling factor in obtaining maximum range conditions and that once the proper speed has been chosen the minimum possible cowl flap opening should be used. The optimum speeds for range have been computed for many different conditions of weight and altitude and cowl flap opening and are listed below:

Gross Weight	*Pilots Indicated Airspeed*
80,000- 90,000 lbs.	180-185
90,000-100,000	185-190
100,000-110,000	190-195
110,000-120,000	195-200
120,000-130,000	200-205
130,000-140,000	205-210

The corrected indicated airspeeds corresponding to the above pilots airspeeds, have been plotted in the curves through which are miles per gallon versus speed curves for various weights and altitudes with probable cowl flap openings. It will be seen that in all cases these speed bands give essentially optimum miles per gallon and are usually slightly fast in order to give better speed, cooling, and better miles per gallon when flying with headwind. It is very important that power conditions be so set up that the resultant speeds lie within these 5 miles per hour bands.

On chart A it can be seen that the speed drops off very rapidly at constant power and fuel flow with increasing cowl flap opening in the speed range near maximum miles per gallon. Engine cooling is obtained at large penalties for speeds less than the recommended range speeds. Therefore the speed must never be allowed to drop below the desired cruising speed given in the table above. The charts given in this Technical Order may be used to approximate the proper power and cowl flap opening for these desired speeds but must be modified if they do not give the proper speeds. The power should be adjusted holding constant speed to obtain level flight. The speed is important and not the power. Cowl flap openings should be the minmium obtainable while still retaining adequate engine cooling and in no case should exceed 10° or 3 inches of opening.

Long range cruising operation may be best set up by the following procedure. The pilot levels off after the climb and allows the airspeed to increase about 15 mph above the climbing speed then reducing power to the approximate cruising power setting (as determined by the engineer from the charts). The engineer then opens the cowl flaps approximately 0 to 1″ more than the climb setting and pilot noses airplane down to maintain speed until head temperatures are below cruising limitations. This will usually take between 500 and 1500 ft. of altitude. The engineer will then close the flaps to the recommended cowl flap settings (listed in the section on cowl flap operation) and the pilot will use the elevators to change the speed of the airplane to the long range cruising speed, as determined from the preceding table. The pilot will then adjust power until altitude can be maintained, and the engineer may adjust the cowl flaps to maintain the head temperatures on individual engines. After cruising condition is established maintain airspeed by holding constant attitude and let airplane altitude vary slightly with normal convection. Use power to correct excessive altitude changes.

Always fly at the proper airspeed with minimum cowl flap opening and have the flight engineer adjust cowl flap settings to obtain maximum allowable temperatures as listed on the instrument panel. *This procedure will give maximum range.* Do not use predetermined powers for long range operation except as a first approximation for setting up the power to maintain recommended long range cruising speed.

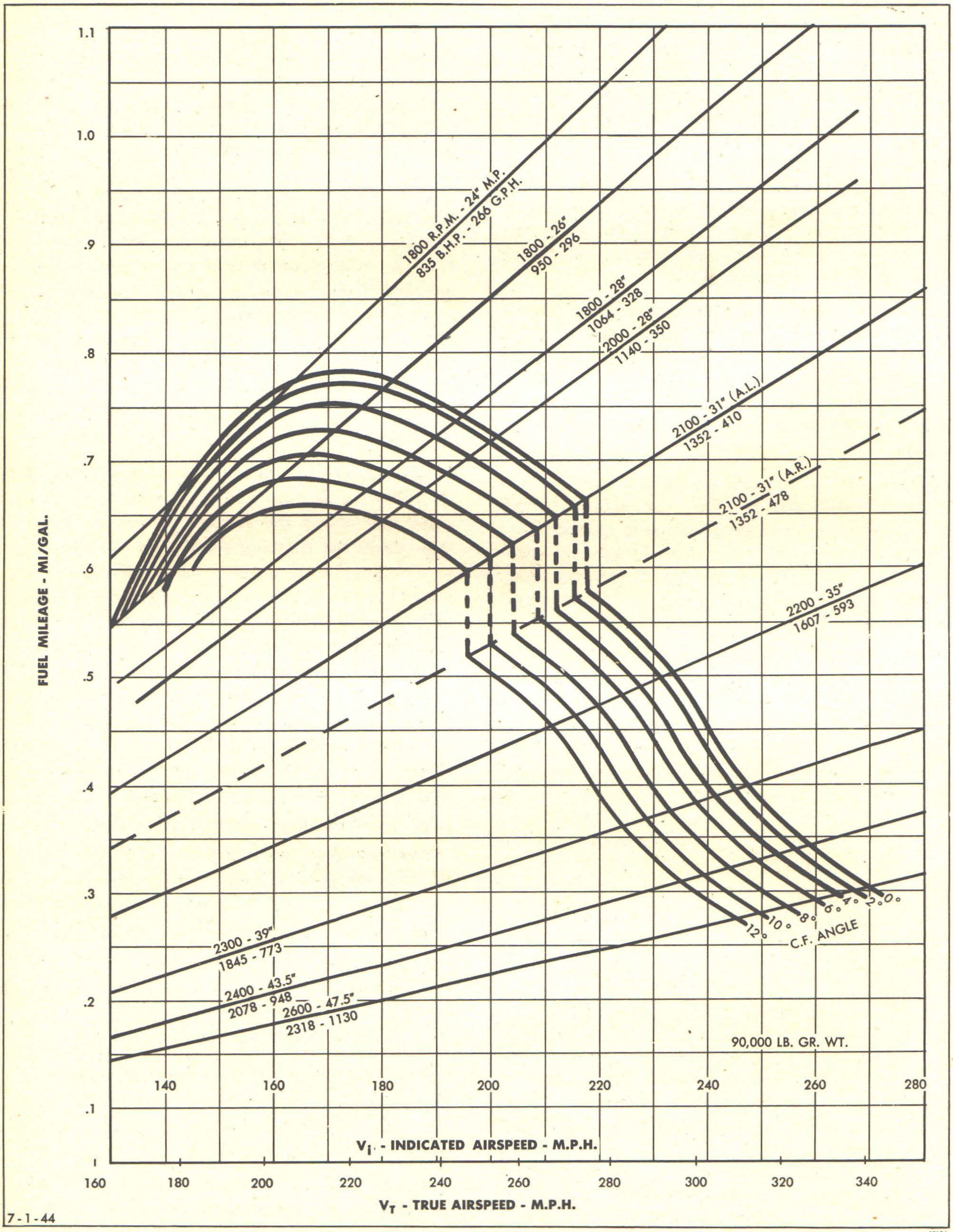

Figure 114 — Mi/Gal vs Air Speed — Four Engines, 15,000 Feet (Various Cowl Flap Settings)

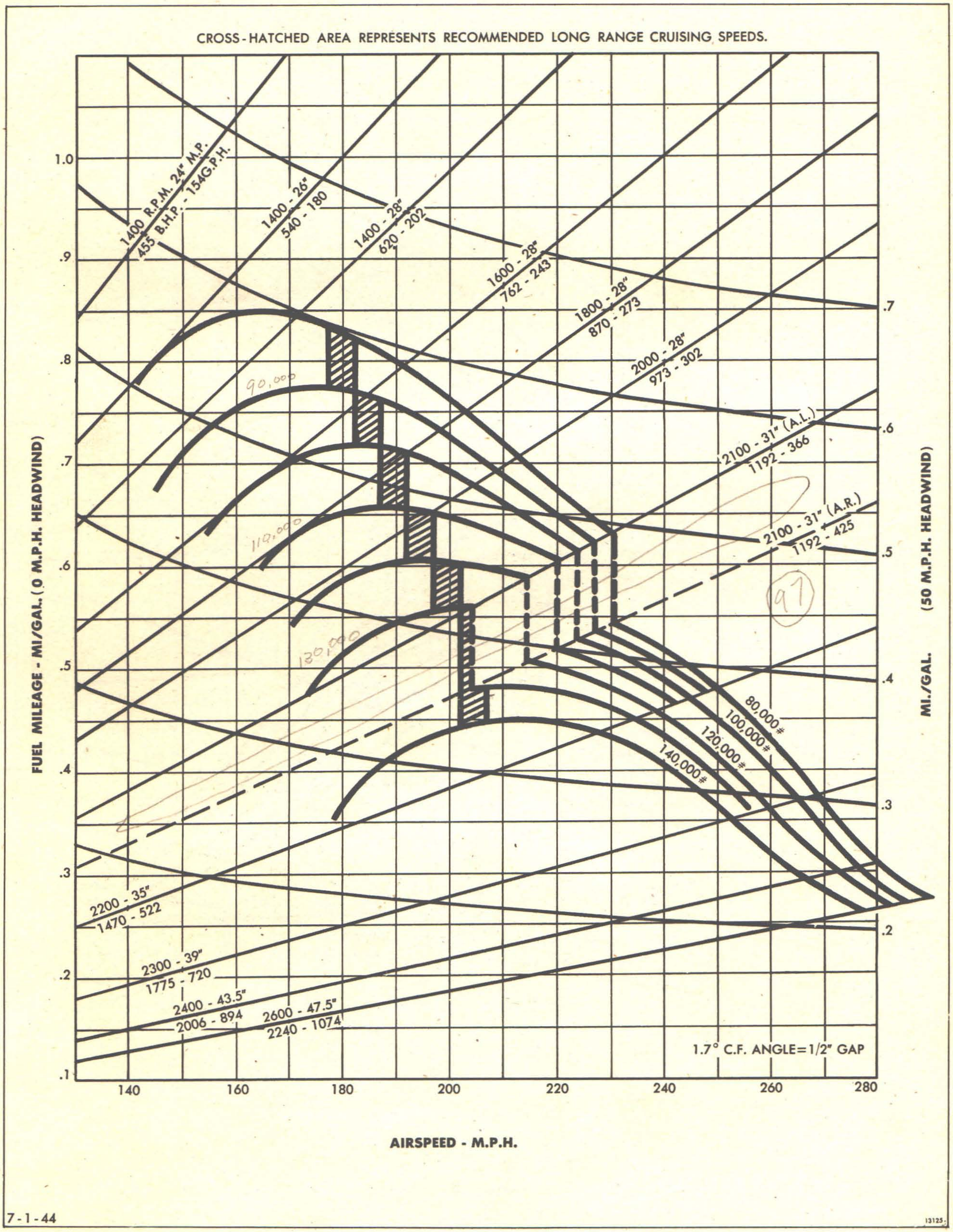

Figure 115 — Mi Gal vs Air Speed — Four Engines, Sea Level

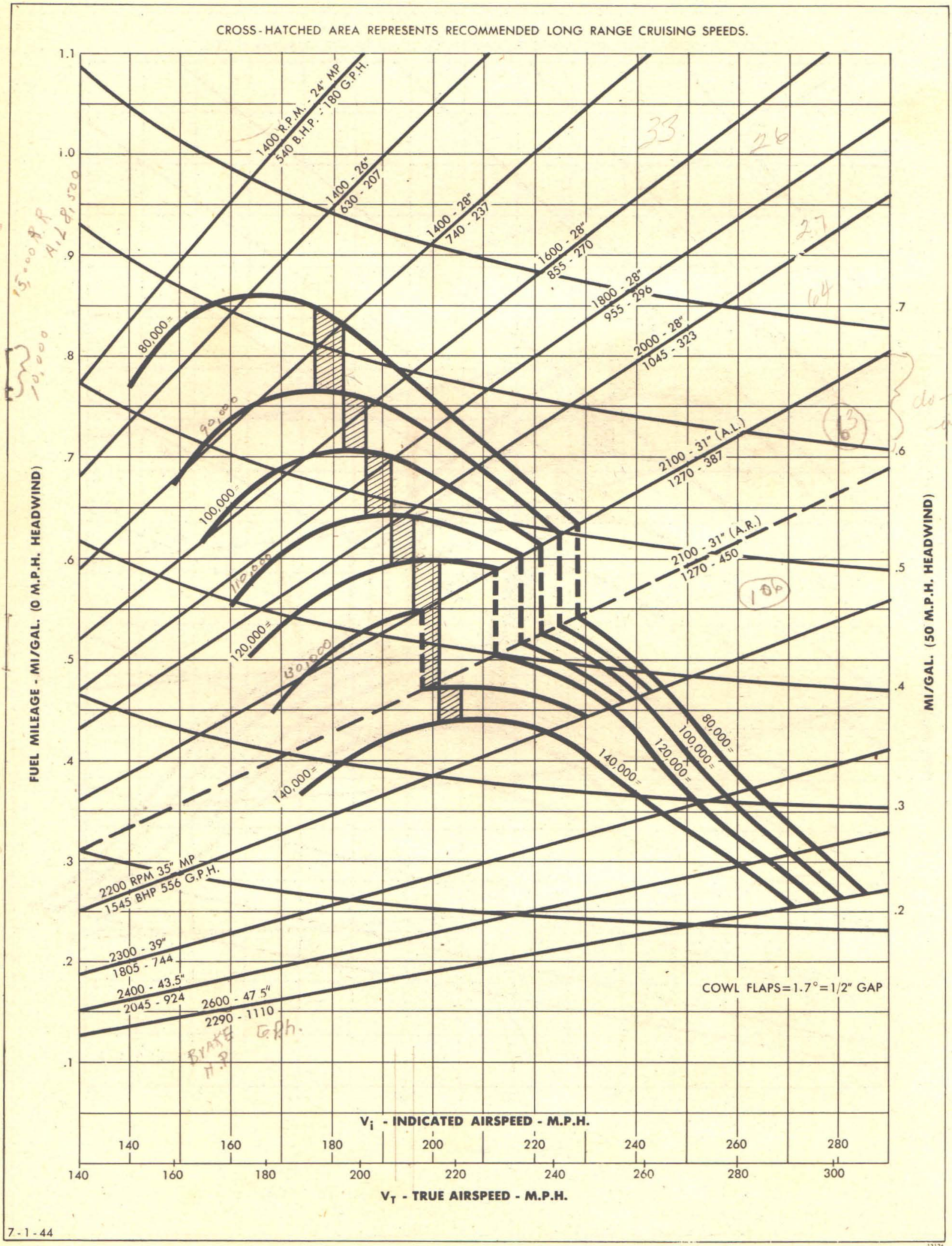

Figure 116 — Mi/Gal vs Air Speed — Four Engines, 5,000 Feet

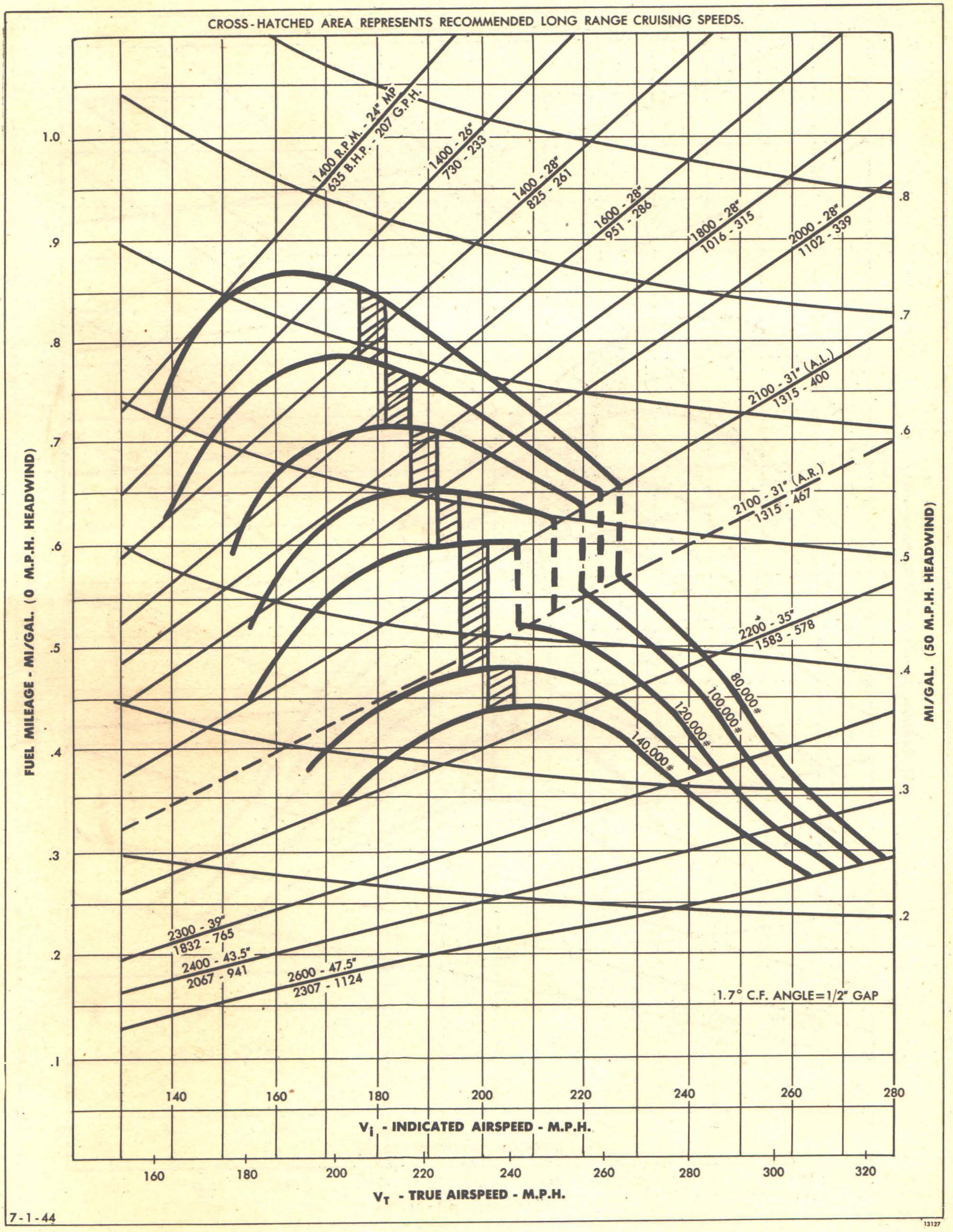

Figure 117 — Mi Gal vs Air Speed — Four Engines, 10,000 Feet

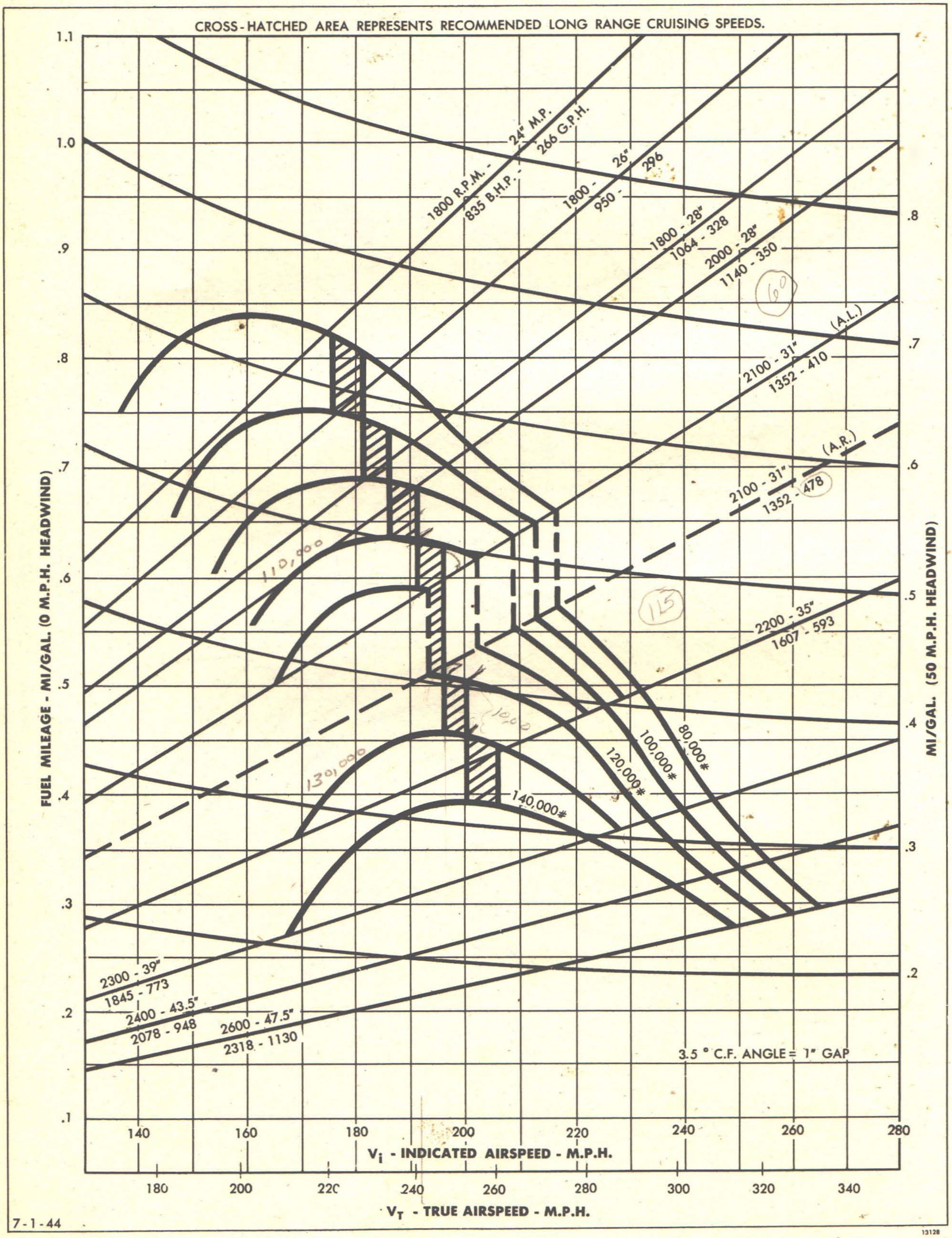

Figure 118— Mi/Gal vs Air Speed — Four Engines, 15,000 Feet

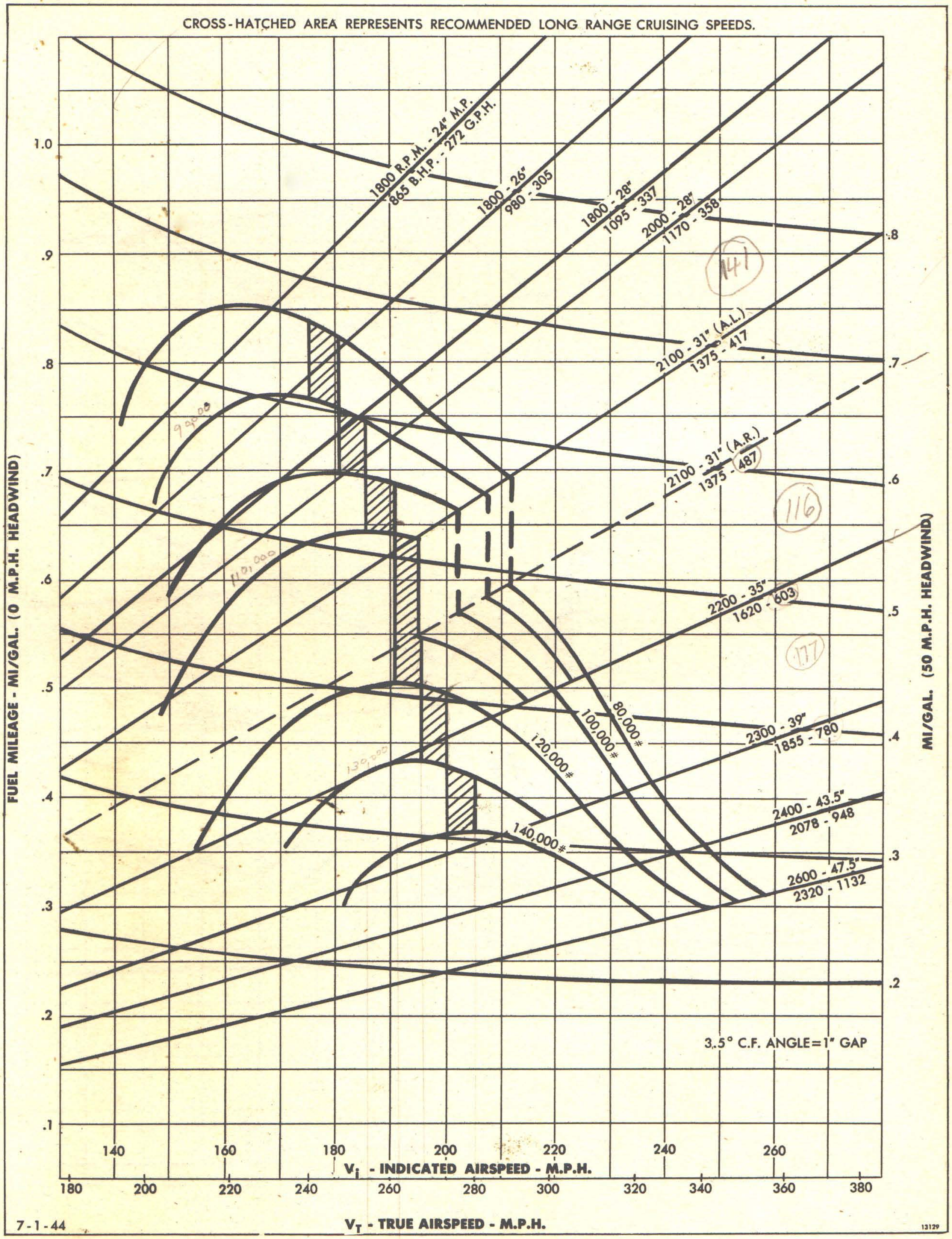

Figure 119 — Mi Gal vs Air Speed — Four Engines, 20,000 Feet

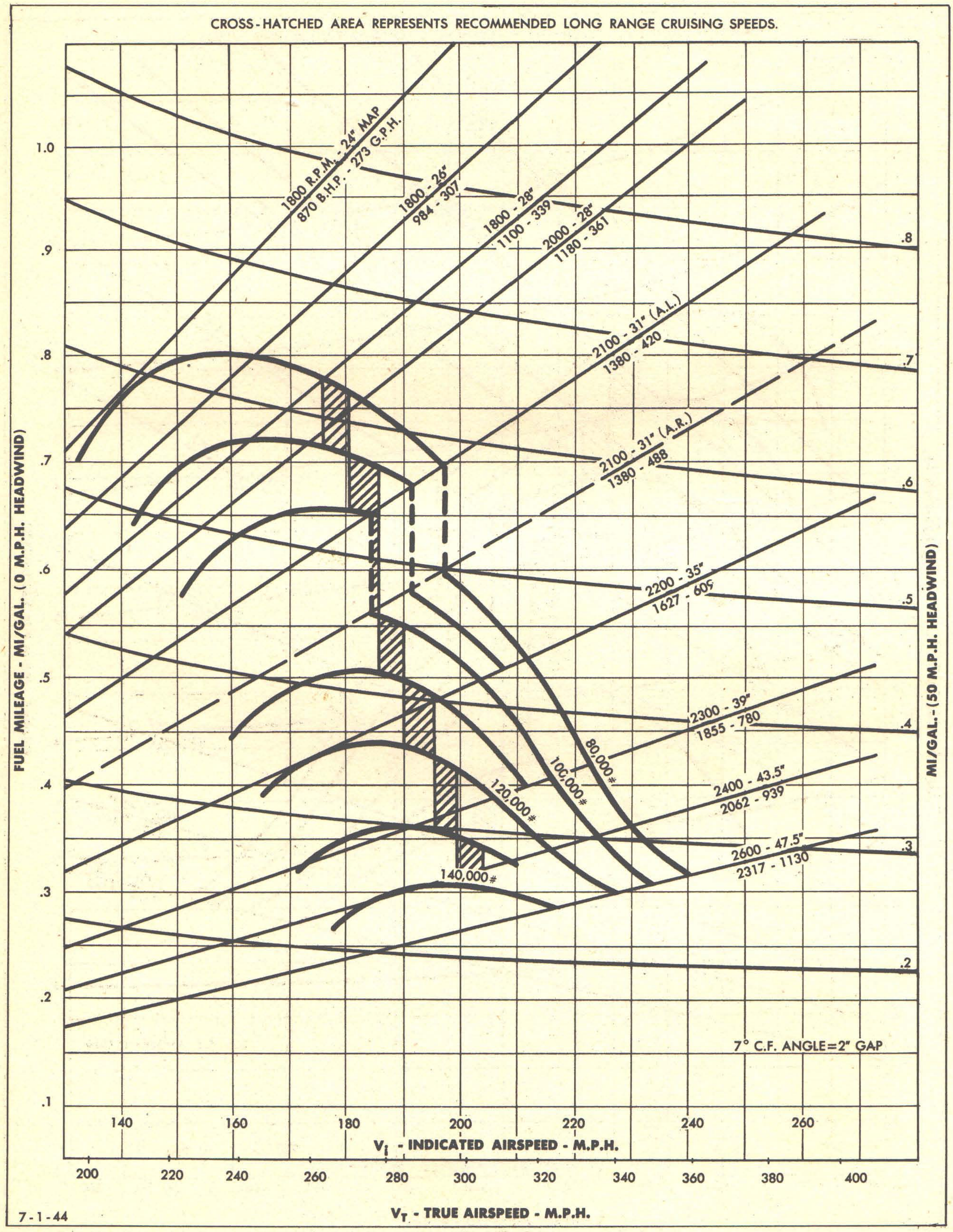

Figure 120 — Mi/Gal vs Air Speed — Four Engines, 25,000 Feet

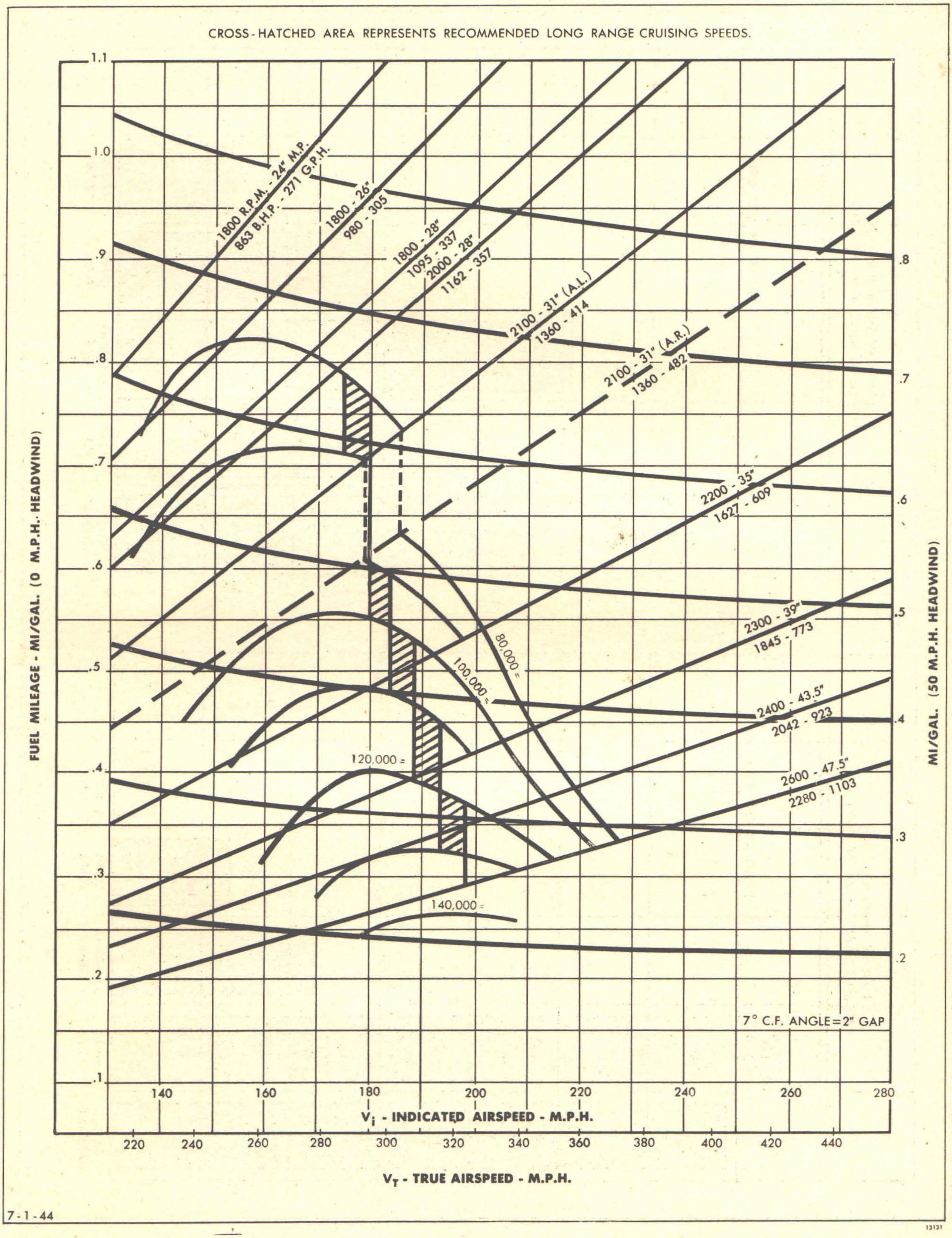

Figure 121 — Mi Gal vs Air Speed — Four Engines, 30,000 Feet

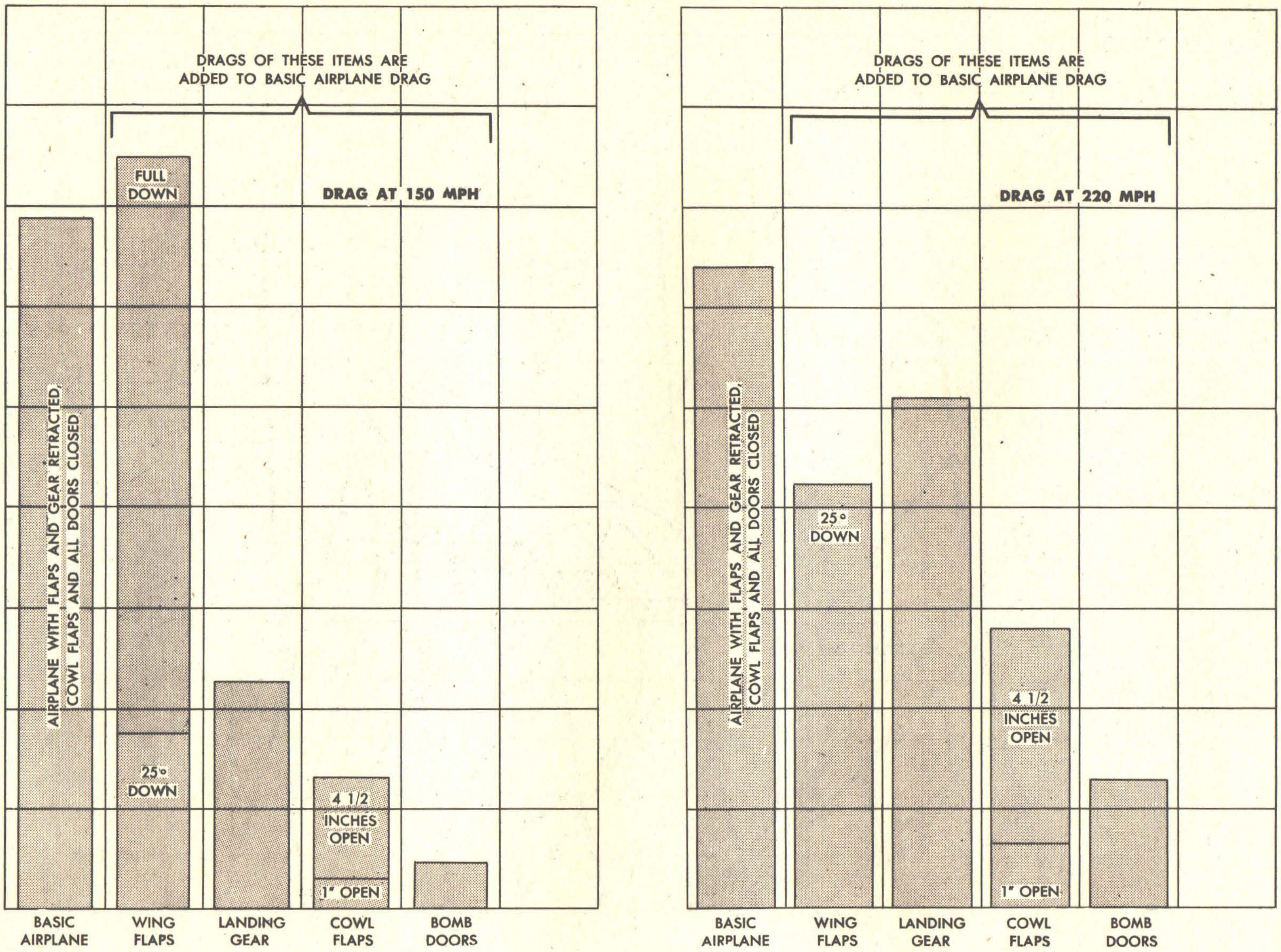

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Figure 122 — Airplane Drag Chart

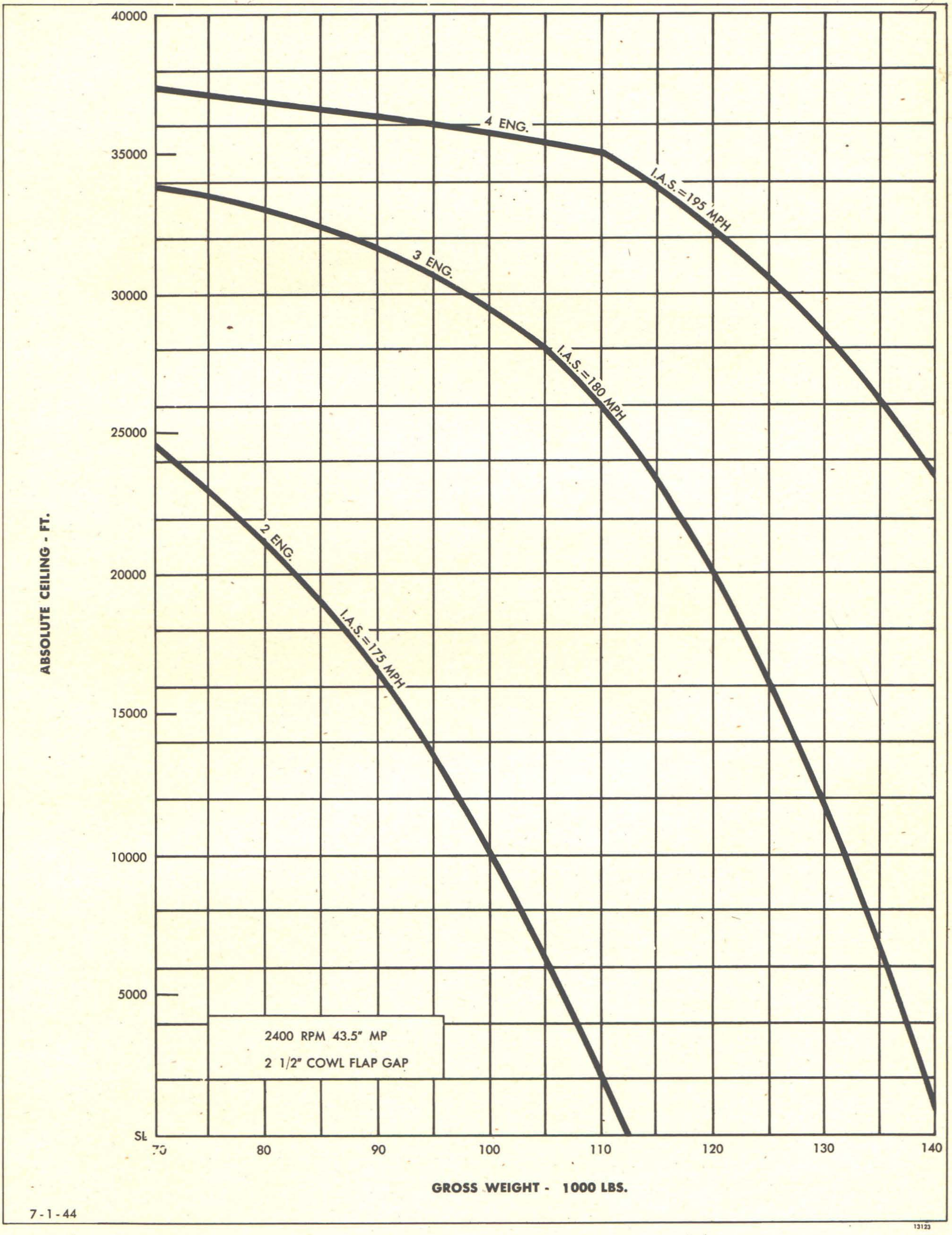

Figure 123 — Absolute Ceiling vs Gross Weight